THE
VARNISHER
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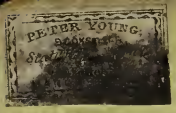
PETER YOUNG,

Ralph Woolley
June 9th 1855.

THE

VARNISHER'S GUIDE;

A PRACTICAL TREATISE

ON THE ART OF

MAKING AND APPLYING VARNISHES,

WITH

OBSERVATIONS AND EXPERIMENTS ON COPAL; THE COMPOSITION OF VARNISH; AND ON VARIOUS PROCESSES USED IN THE ART.

BY

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THIRD EDITION,

CORRECTED AND IMPROVED BY A PRACTICAL CHEMIST.

ILLUSTRATED WITH ENGRAVINGS.

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PREFACE.

It having been determined to divide the *Painter's and Varnisher's Guide* of Professor Tingry into two volumes, chiefly for the convenience of persons connected with the respective arts, and also in order to render the contents of each more acceptable to the public generally, by printing it in a cheaper form; the volume on *Varnishes* is now respectfully offered as a manual of the art, which contains not only every thing of importance that the *Second* Edition of M. Tingry contained, but also a variety of other information from the Editor's own resources, as well as details concerning the most recently-discovered facts, and hints, collected from the best authorities, both foreign and domestic; and which must, it is presumed,

render this Treatise on Varnish an important accession to the library of useful knowledge.

It is scarcely necessary to add, that the simplest style and the most intelligible language, as in the *Painter's Guide,* (which has met with the best acceptance from the public,) have been also employed in this work.

The *weights* and *measures* are all stated agreeably to British standards. Whenever *pints* or *gallons* are mentioned, they are to be understood as the *old wine,* and not the new *imperial* measure.

J. J.

London, May, 1832.

DIRECTIONS TO THE BINDER.

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THE

VARNISHER'S GUIDE.

CHAPTER I.

INTRODUCTION.

THE word VARNISH is a general expression used to denote every dry or liquid substance, the extension of which over solid bodies gives lustre to their surfaces. There are, nevertheless, many substances which may be confounded with those which produce such lustre in a permanent manner. Thus water, oil, and, indeed, every fluid spread over the surface of polished wood, soon change its appearance, and give it a certain lustre, which must not be confounded with that resulting from the application of a real varnish, because this effect is not permanent.

The case is not the same with pure gums, such as that from the cherry-tree, plum-tree, &c.; and, in particular, gum-arabic when diluted with a certain quantity of water. These substances form real varnishes, the effect of which is permanent, and which is sometimes

employed with success, to preserve from alteration certain porous bodies, such as eggs; and to heighten in other bodies the splendour of their natural colours, as is the case in regard to shells. In the last place, isinglass, or other gelatine, diluted with water, participates in the same properties. In a word, every liquid, transparent substance which is susceptible of uniform extension over a solid body, which is not entirely dissipated, but evaporates in part, exhibits the phenomena of a varnish.

The etymology of the word *varnish* is uncertain: some derive it from a Greek word βερνικη, used by the barbarous Grecians for amber; others from *vernus ros*, the vernal dew. The Latins have the word *vernix*, whence, or from the French *vernis*, our word *varnish* is, doubtless, derived: in the language of the former it signifies gum-juniper as well as varnish, because this gum, it is said, was the first substance used by the ancients in the composition of varnish. That varnishes of some kinds were used in the earliest ages when the art of painting was exercised there is no doubt; although we have no documents handed down to us from the ancients which will inform us of what the varnishes which they used were composed. An examination of a mummy case at Cambridge some time since, proved that the varnish which covered the colours could not be dissolved or the least affected by common water; and it equally resisted the dissolving power of alcohol; hence, it is probable that such cases were not covered with sizes or with simple gums, but with an oil varnish.

The Greeks obtained their first knowledge of the arts, there can be no doubt, from the Egyptians. It appears also almost certain, that the varnishes which have been made and employed for many centuries, by the nations who inhabit the eastern parts of Asia, were in part also known to the Romans. In regard to the Grecian paintings, such as those of Apelles, Protogenes, and others, it has been questioned whether the preservation of the colouring was owing to a varnish, or to substances capable of making a varnish. Did these painters mix them as the moderns do with the colouring parts, even when distributed on the palette? or did they reserve them to be applied to the composition after it was finished?

The latest inquiries relative to this subject do not enable us to resolve those questions. That the Greeks and Romans employed oil varnishes we cannot doubt, although, from the absence of examples of their art, we cannot prove the truth of our proposition by an appeal to fact.

One of the greatest obstacles to the diffusion of knowledge throughout all the periods of antiquity, previously to the discovery of the *art of printing*, was the absence of such a method of conveying it: for books in manuscript were, comparatively, both expensive and rare, and within the reach of very few persons; added to which, the *manipulations of art* were rarely, perhaps, committed even to paper, much less made public, as those who possessed *secrets* of that kind were prompted to keep them such for their individual emolument; even in our own times this spirit is still, on very many occa-

sions, exceedingly predominant: hence, most probably, the reason that we know so little of such arts among the ancients.

That the *Chinese*, *Japanese*, and some other eastern nations, have for many ages possessed a knowledge of the art of making varnishes, and of applying them to preserve and ornament various articles both of luxury and utility, cannot for a moment be questioned: indeed, so important have the wares of *Japan* been deemed, that we have in this country a well-known artist called the *Japanner:* and we may add, too, that so important has the trade of a Japanner become, that artists of the first talents are employed in it: we may name here, what, perhaps, is not generally known, that the celebrated BIRD, the painter, was for some years employed as a decorator of *Japan-ware.* That the eastern nations were more particularly excited to the use of varnish from some of the juices of their indigenous trees being in themselves a good varnish, there is little doubt. One of these trees, the *rhus vernix*, or, *varnish sumach*, produces, it is said, the true *Japan varnish*, which oozes out of the tree on its being wounded, and grows thick and black when exposed to the air. It is, nevertheless, said to be so transparent, that when laid pure and unmixed upon boxes or furniture, every vein of the wood may be clearly seen. The whole of this shrub is, however, in a high degree poisonous.

The art of making and employing varnishes is, notwithstanding, of comparatively modern date in Europe: it may be carried back to the fourteenth century; and if the

Chinese and other eastern nations preceded us in this art, it was, most probably, owing to their indigenous *varnish trees*, rather than from any researches of their own.

The spirit of imitation, strengthened by the knowledge acquired of chemical analysis, at length naturalized in France an art which seemed confined to the remotest parts of Asia. The observations of the Jesuit missionaries *, on certain arts cultivated by the Chinese, excited the attention of our artists, and induced them to repeat the processes of the inventors.

In the year 1737, in consequence of some varnished articles brought from China, the French artists exhibited so much enthusiasm for imitating this varnish, which was represented as being unalterable by fire, that people were almost disposed to prefer varnished to metallic vessels. Those attempts to obtain an incombustible varnish gave birth at length to a new art, that of making varnished paper snuff-boxes, &c.

But as the improvement and discoveries in chemistry have necessarily an influence on the progress of all arts, with so many branches of which chemistry is closely allied, the *art of varnishing* has received considerable advantages from that all-comprehensive science: the substances employed in varnishes have, therefore, been better studied, and can now be combined and applied with greater facility †.

* See *Lettres édificantes* et *curieuses*, published by the Jesuits. The details of Father d'Incaville, respecting the China varnish, may be seen in the *Mémoires des Savans Etrangers*, vol. iii.

† To the former editions of this work was prefixed *a Report to the*

An art so fertile in resources could no longer, therefore, be confined to external objects of luxury. A taste for the decorations applied to apartments, during this continued and progressive improvement, was extended from palaces to the habitations of the rich, and by the effect of imitation was transferred thence to the humble abode of the citizen in easy circumstances.

The processes, however, employed at this period were agreeable to the experience of artists who had been engaged, for the most part, in those simple operations used for painting in distemper. The most intelligent confined themselves to a series of processes for which they were indebted to particular researches, or to communications from amateurs distinguished by their fortune or their knowledge, or which they obtained from venders of secrets, a kind of people who are very common in professions founded on chemical operations. Each process, therefore, bore evident marks of the ignorance or inexperience of the artist. Hence the differences observed in the colouring, brilliancy, consistence, tenacity, or dryness of the varnish employed. The operator, too, easily satisfied with his first attempts, proceeded no fur-

Committee of Chemistry of the Society of Geneva, for the Encouragement of the Arts, on M. TINGRY'S *Treatise on the Art of preparing varnishes, and of composing the colours mixed up with them,* by M. SENEBIER. This report does great credit to M. Tingry's work, and deserved a place in its first editions; but as its credit is now so firmly established, it does not appear necessary to reprint it again with the present edition. What, however, in that report is esteemed useful to the varnish-maker, has been combined with the text in this introduction, or in other parts of the work.—EDITOR.

ther in the improvement of his art. The secret was the more strictly observed, as it seemed to secure a certain resource to the industry and family of the possessor. Hence also that incoherence in the formulæ which different works seemed to confirm, and which they extol as the properest for answering the intended purpose. Hence, also, that immense collection of obscure recipes, said to be derived from the best sources, which artists of ability soon condemn, because they find them at variance with the true principles of the art. The works entitled *Les Secrets des Arts et Metiers* *, *Le Dictionnaire des Arts*, *L'Art du Vernisseur*, *Le Parfait Vernisseur*, and other small essays of this kind, abound with faults, which deprive them of the merit attached to good elementary works, and to methodical descriptions of the arts.

The interest of the practitioner, therefore, prevented the art from approaching towards a just theory. It was, however, necessary that the latter should become the basis of all future researches, in order to throw light on the different processes, to ascertain the nature of the results

* A work in four large volumes, with the attracting title of *Secrets concernant les Arts et Metiers*, was published a few years ago. It is a crude compilation of all the processes with which the different periods of the various arts on which it treats have been encumbered. The art of varnishing occupies a whole volume, which contains, without choice, every thing, good or bad, relating to it. One may readily perceive that it is more calculated to mislead the artist amidst a labyrinth of contradictory formulæ, than to guide him in his progress by a series of principles which might enable him to banish every thing foreign to the main object of his researches.

by a rigorous comparison, and thus to establish the real principles of the art. This happy effect was, in part, produced by the public spirit of an artist who was so generous as to disclose some processes which I here propose to examine, presenting them in a new order of distribution, and adding the necessary observations.

WATIN, to whom I here allude, did not forget the interest of the artist when he intrusted his precepts to the writer charged with preparing them for the press. But while he reserved the secret of certain processes, which were his own, he did not observe that by contributing to reduce the art to certain principles, he at the same time prepared means for lessening its difficulties, and of enabling artists to arrive speedily at that happy period when all reserve becomes useless or ridiculous. Had he laid open all his processes, he would certainly have acted more consistent with those principles by which he seems to have been generally guided.

Notwithstanding his reserve, which displays in a striking manner the spirit by which even the most experienced artists are influenced, his work will always form an epoch in the art of varnishing. He unites in the same point of view a series of practical precepts founded on long experience, and which have hitherto been followed by the most intelligent painters : but the greater part of those who in country places exercise this profession are guided in their operations by a faulty routine. Whatever treatise may in future be written on this useful art, it can only clear the path, which this

author has in some measure traced out, from the shackles which real theory always imposes on the artist who is merely a manipulator; and no addition in this respect can in any manner lessen the favourable opinion with which Watin's work was received. With this spirit I undertook to review a subject which has been treated by various authors, considering it under its different aspects, combining it with every thing reserved for it by the new chemistry, and with many other arts which seem to require from it a new support.

It is much to be wished that this devotion to the public interest were more imitated by artists of every class; but particularly by those whose manipulations depend on chemical mixtures or combinations, as in the manufacturing of printed cottons, the art of making paper hangings, in dyeing, &c., the various formulæ of which are scattered among the conductors of manufactories. These processes, which for the most part have been the fruit of some accidental circumstances, would soon experience, by the free concurrence of artists and chemists, advantageous modifications which would lead to new discoveries. Society would thus be enriched with good descriptions of the arts; and these would add to the great importance attached to those valuable collections published by the ci-devant Academy of Sciences at Paris, in regard to objects which have a powerful influence on the happiness and prosperity of empires.

It is not my intention to follow the art of the varnisher through all the details which may seem suited to those artists who are more particularly employed in the deco-

ration of carriages and other objects of luxury. I shall more immediately confine myself to an illustration of the principles. These alone are applicable to all circumstances in which the painter and varnisher are interested. They will lose nothing by being condensed: and if they conduct the pupil and amateur, by a sure path, to that eminence from which they can see the extent of the art, they cannot be foreign to those complete artists who, by their talents and their masterpieces, contribute to feed the luxury of large cities.

My object is to place in a conspicuous point of view every thing that can assist the varnisher and painter in regard to matters which fall within the province of their profession ; and in some measure, to conduct the amateur by the hand.

The composition of varnish is connected with a particular kind of knowledge respecting the physical and chemical properties of the dry or liquid substances which form its constituent parts. The study of these objects must induce artists to follow them in the effects which arise from the extreme division they experience, when brought into contact, according to certain laws. The kind of chemical phenomenon which takes place in the latter case depends, then, on rules and precepts established by experience. The art is gradually enlarged by all those parts which seem to have a coincident relation. Painting in distemper preceded the discovery of painting in oil ; and the latter was some years anterior, as appears, to the invention and application of varnish. These three parts touch each other in inseparable points ;

but they have each their distinct rules, and are sufficiently rich in matters to justify the appropriation of one division of the work to a particular description of them. I have, therefore, been induced to divide this treatise into two parts.

The first comprehends an historical account of the dry or liquid substances which concur towards the composition of varnish.

The ingredients employed in the different compositions of varnish are described, in general, in works which form no part of the libraries of pupils or of artists. I therefore considered it my duty to introduce this subject, to banish from it all those articles which are foreign to the art, and to subjoin such observations as I thought useful, because they appeared to me proper to excite a taste for study, to facilitate instruction, and to concur in a direct manner to produce that body of information which is expected in a methodical work.

It was necessary that an examination of the dry substances should be followed by an account of the different fluids employed as vehicles in these compositions. A mere nomenclature would not have excited that interest which the study of them requires.

I then proceed to general observations on varnishes: which are followed by a distribution of them into two classes. The latter of these, or that which I have here chiefly in view, is subdivided into five genera, each containing a certain number of species, or particular kinds, which are admitted into these genera according to their

nature, their consistence, and the properties of their component parts.

This division, which is, it is presumed, well calculated to facilitate a knowledge of them, is followed by an examination of general precepts in regard to the composition of varnish on a large scale. The object I had here in view could have been answered only in an imperfect manner if, in following all the details of the manipulations, I had neglected the means of rectifying them, in such a manner as to secure artists from those serious accidents with which these operations are often accompanied. I conceived that the use of an alembic of a new form might facilitate that rotatory motion which must necessarily be given to the matters inclosed in it, and at the same time prevent those inconveniences which arise from the too sudden tumefaction or evaporation of the inflammable liquid.

It was necessary, also, that I should communicate to artists some observations, which are still more particularly my own, in regard to the solution of copal in oil of turpentine, a fact contested by Watin, though it seemed to be proved by some experiments of Lehman. The secret cause of this difference of opinion deserves to be known, as well as every thing that can facilitate the use of copal varnish made with oil of turpentine or with ether.

If the first part of this treatise is destined to make known the substances which concur to the composition of varnish, as well as the processes by which artists are

enabled to give them the requisite properties, the second, which contains an examination of the colouring substances, and of every thing that relates to the different branches of common painting, can be no less interesting to the artist and the amateur. After describing these substances, I proceed to observations which seem to arise from the subject; such as those on the origin of colours, and on the particular processes which enrich the art of varnishing with a great number of colouring substances, not always furnished by nature in that state in which the painter employs them. The artist is then presented with some particular results which may encourage him to give greater extent to the use of certain varnishes proper for repairing enamelled articles damaged by accidents. These varnishes are attended also with another advantage, that of favouring a new kind of manufacture, which may be distinguished by the name of false enamel, or enamel by varnish.

In describing the different preparations, the reader will be conducted from the simple to the compound. He will be enabled to follow the transitions from the lightest colours to those which, with the same varnishes, borrow from the nature of the colouring substances modifications of tints, well calculated to enlarge the ideas he may have formed in regard to the richness of the art, and the extent of the resources it displays by the efforts of genius, when destined for the sublime kind of painting.

It is not sufficient that artists should know how to prepare or to procure the colours or varnishes which

they intend to apply to any article: they must know also how to make use of them. This department of the art has its rules and precepts, which must be studied or consulted when the colours employed are destined for distemper, for varnish, or for oil. This object is of as much importance as that of composition, and requires to be treated separately.

I have taken advantage of some particular experiments to give an account of several processes belonging to a branch of manufacture which has a direct relation to the subject of this work, and which, as far as I know, has never yet been described: I here mean the art of making wax cloths (oil cloths).

This order in the distribution of the matters to be treated of would not have entirely answered the proposed purpose, had I omitted to describe, according to the principles of the pneumatic doctrine, such objects as are susceptible of it. There can be no doubt that this part of the work will be that least acceptable to the artist, who through habit is unwilling to give up his old nomenclature. But persons in the least familiar with this language will find full compensation in the satisfaction which accompanies an examination of the physical and chemical properties of the substances I shall have to describe, and in the historical account of the changes produced in them by art. I shall, however, still keep in mind that I ought to confine myself to those points which justify the changes prescribed by the present system of chemistry in the common expressions employed to distinguish them. The addition of the terms established

by the new nomenclature, to those which are familiar to them, will gradually accustom artists to adopt them readily without any loss to the art.

In addition to the preceding observations, which are essentially, although somewhat abridged, the introduction to the former editions of M. Tingry's work as far as relates to VARNISHES, it should be known that for many of his introductory observations on PAINTING, recourse must be had to the third edition of his work, entitled *the Painter's and Colourman's Complete Guide, corrected and improved by a practical Chemist*, and published in a separate volume in 1830, to which the present is designed to be a companion.

It may be also useful to state here, that although the manipulations for the preparation of varnishes, as directed by M. TINGRY, are carefully and correctly preserved in the present edition, not only will the accounts of the substances which enter into the composition of the different varnishes be found more correct, but a variety of forms are added for the preparations of varnishes which were wholly unknown to M. Tingry, but which the researches of modern art have from time to time developed.

CHAPTER II.

Historical account of the nature and properties of the substances which form the bases of Varnishes, and the external qualities by which the best kinds may be known.

ASPHALTUM, BITUMEN JUDAICUM, OR JEW'S-PITCH.

ASPHALTUM is a bituminous substance which in some countries is very abundant. It is found in a liquid or soft state on the surface of the lake *Asphaltis* or Dead Sea in Judea, hence one of its names. By age it grows dry and hard. It is also found in China and America, particularly in the island of Trinidad; also in the Carpathian Hills, France, Neufchatel, &c.

Good Asphaltum is solid and brittle, breaks with a polish, and is black or of a dark brown colour; it melts easily when heated, and, when pure, burns without leaving any ashes. It is heavier than water, and readily soluble in naphtha and some other oleous bodies. It is often adulterated. When cold it emits very little smell, but when inflamed it has a strong penetrating bituminous odour. The Egyptians used it in embalming their dead, for which it is well adapted. The Babylonians used it for mortar.

GUM-BENJAMIN, OR BENZOIN.

Benjamin is a hard, dry, brittle, white, brownish or yellowish inflammable substance, of a somewhat pungent taste, and which, when thrown on burning coals, emits a peculiar penetrating odour. It is obtained from the *Styrax benzoin* or Benjamin tree, growing chiefly in the island of Sumatra in the East Indies, by wounding the bark near the lower branches. The benzoic acid, which forms the essential character of benjamin, is not used in varnish. Benjamin ought to be chosen with as little colour as possible; and if purity be required in the varnish, it will be proper to employ only the white tears. Benjamin readily dissolves in spirit of wine, and forms a varnish of an agreeable odour, which retains a considerable degree of tenacity, and belongs to those kinds which are slightly coloured.

CAMPHOR.

Camphor is a whitish, crystalline, friable, semitransparent, unctuous substance, having a strong, peculiar, and penetrating odour. It has a bitter, pungent taste, occasioning at the same time a sensation of cold. It is volatile, and should be, therefore, kept in well-stopped vessels. It dissolves entirely and with great facility in rectified spirit of wine, from which it is precipitated in white flakes when water is added to the solution. It combines with oils both fixed and volatile, and it readily inflames.

The camphor sold in the shops is obtained from the

Dryobalanops Camphora, a tree which grows in great abundance in the large islands of the East Indies, such as Sumatra, Borneo, Java, Japan, &c., but is also occasionally obtained from other trees of the laurel tribe.

The use of camphor for varnish is limited: too great a quantity would render it mealy. It possesses the property of facilitating the solution of certain resins, which are exceedingly refractory to the *dissolving* action of their appropriate liquors. Its union with copal is not easily destroyed: in this combination camphor loses its volatility, and the copal its hardness and consistence: the result at length is a flexible mass, which retains a long time its elasticity. Camphor, however, when united in proper doses to other resins, gives toughness to the varnish, and prevents it from cracking. The weight of half an ounce to from five-eighths to a pound of spirit of wine must not be exceeded. The latter proportion is that suited to oil of turpentine.

CAOUTCHOUC, ELASTIC GUM, OR INDIAN RUBBER.

This singular substance is most commonly obtained by incision from the *siphonia elastica*, a large and branched tree which grows in Guiana, and other parts of South America. It is now, however, well ascertained, that several trees, natives of the East Indies, and other tropical climates, yield a similar substance which is applicable to the same purposes.

When it first flows from the tree it is a yellowish-white juice, which becomes hard and dark-coloured by exposure to the air. The inhabitants of South America pre-

pare it for use by applying it in successive coatings on a mould of clay, which are dried by the fire or in the sun; when of a sufficient thickness the mould is crushed and the clay shaken out. Its elasticity is one of its distinguishing characteristics. When warmed by immersion in hot water, slips of it may be drawn out to a great length, yet it will return to nearly its former dimensions. Cold renders it rigid; warmth gives it its original elasticity. Its solvents are ether, volatile oils, and petroleum. Mr. Faraday has lately detailed some curious experiments on the juice obtained from Mexico, nearly as it exudes from the tree. *Journal of Science*, Vol. XXI.

ISINGLASS, OR FISH GLUE.

Isinglass, fish glue, or ichthyocolla, is chiefly prepared from the air-bladder of the *acipenser sturio*, or *common sturgeon*, and the *acipenser huso*, which is found in the river Wolga. It may, however, be obtained from many of the membranous parts of several fish: it is, in fact, the purest kind of gelatine which can be obtained from animal bodies, without the trouble of much purification. According to Dr. URE, 100 grains of good dry isinglass contain rather more than 98 of matter soluble in water. That isinglass which does not dissolve nearly, if not entirely, in boiling water, must be considered of an inferior quality.

Isinglass is much used for giving a lustre and stiffness to ribbons and gauzes. It is a kind of varnish; it is also the basis of the English court-plaster.

In the art of varnishing, it is employed for defending

cut-paper works, &c. from the attacks of the varnish applied to them. Without this precaution the varnish would be imbibed, and form spots. Dissolved in spirit of wine it also forms a useful varnish *.

It is obvious also that

GLUE

made from other substances may be also employed on many occasions instead of isinglass, where colour is of no importance; but it is not necessary that we should enter farther into this matter here.

COPAL.

Copal is a resinous substance, for the most part in large dry solid tears, of a yellowish white or lemon colour, and semi-transparent. It is said to be the product of a tree, the *rhus copallinum*, native of Spanish America.

Copal is obtained also in the East Indies, from, it is said, the *elæocarpus copallifera*. But the trees whence copal is obtained do not appear to be accurately known in Europe.

Copal emits a strong odour when burnt.

It was first known under the name of gum copal; but the phenomena it exhibits in the fire, and its being insoluble in water, proves it to be a peculiar resin. The principal chemical properties of copal are as follow:

It is in part soluble in spirit of wine, when directly

* See Craig's Lectures on Painting.

applied; that is to say, without any intermediate substance.

It is wholly soluble in spirit of wine, when, being very much divided, it is first subjected to the action of a fluid less aqueous than spirit of wine, and which becomes a medium that facilitates its union with it. This effect is obtained by beginning the solution in oil of lavender. It is also soluble in oil of rosemary.

It is wholly soluble in oil of turpentine, and without any intermediate substance, after the latter has acquired particular properties by exposure to light; or when the copal has undergone a particular modification from heat.

It is wholly soluble in sulphuric ether, and without any intermediate substance.

The addition of copal to certain resins contributes to the durability, and even to the splendour and brilliancy of the varnish; but when this mixture is used the copal ought to be ground in small quantities, with large proportions of resins readily soluble in spirit of wine.

GUM TRAGACANTH, OR DRAGON.

This gum is obtained from a shrub, the *astragalus verus*, a native of the north of Persia. It is brought to this country by way of Aleppo. It is in thin and wrinkled worm-like pieces, of a colour more or less white, dry, inodorous, and has a slightly bitter taste.

It ought to be chosen pure, white, and transparent: that which is yellow, black, or mixed with foreign bodies, must be rejected.

When put to soak in water it swells up a great deal, and assumes the consistence of very thick mucilage. This mucilage is sometimes employed by miniature painters, when they are desirous of rendering the vellum on which they paint as smooth as a plate of ivory. For this purpose they put the mucilage into a piece of fine linen, tie it into a knot, and rub it over the vellum.

In painting in distemper a solution of gum tragacanth is substituted for solution of gum arabic, in mixing up colours of a saline nature. This mucilage has more body than that of gum arabic, and when dry is less liable to crack.

GUM ARABIC.

This gum exudes naturally from the fissures in the bark, and from incisions made in the trunk of the *real Egyptian acacia (acacia vera,)* which abounds in Egypt, in Arabia, Senegal, and several places in Africa. It is found in pieces of different sizes, sometimes round, sometimes angular, and sometimes folded double. They are of a yellowish-white colour, brittle and brilliant. They are soluble in water, and render it glutinous.

In general, the mucilage from *Senegal gum* (which is of a reddish colour, and in larger drops than those of gum arabic) has not the same softness as that from this last-named gum, which, when dry and white, is, in all cases, to be preferred.

It is used for covering delicate articles intended to be varnished, such as cut paper work, &c. This mucilage

preserves the ground and colours from being affected by oleous or spirituous varnish.

To these aqueous varnishes may be added that supplied from the albumen of

EGGS.

It will be sufficient to observe, that upon many occasions the white of eggs makes a valuable varnish, it uniting not only with water, but also with rectified spirit of wine, and, of course, with proof spirit.

STICK LAC—SEED LAC—SHELL LAC.

Lac is obtained from the branches of different trees, and, it is said, also on reeds growing in the East Indies. It constitutes the nest of an insect, the *coccus lacca*. It appears to be a secretion from the female, and is formed into cells with much art and regularity. The inhabitants collect it twice a year.

It is known in three states. *Stick lac* is that still attached to the sticks on which it has been deposited; *seed lac* is the same after it has been separated from these twigs; and *shell lac* is also the same which has been melted and cast into thin laminæ.

Lac is not a pure resin; as it does not dissolve entirely in rectified spirit of wine. The residuum consists chiefly of a red colouring matter, wax, and gluten.

Seed lac gives a tough strong varnish, which is employed for musical instruments, such as violins, basses, &c. For this purpose it may be used in the state in which it comes from the shops, that is to say, in grains;

but in this state it is deprived of its colouring parts, which the Indians apply to their printed cottons, so much sought after in Europe on account of the fixity and brightness of their colours. The want of this colouring part may be supplied by an infusion of annatto, which increases the beauty of the varnish designed for musical instruments.

Shell lac is prepared from stick lac, which is washed in water to carry off the colouring part; it is then melted, and poured on a marble table, over which it is spread out to be formed into thin laminæ. It is one of the principal ingredients of sealing-wax. According to the experiments of Mr. Hatchett, shell lac contains by far the greatest quantity of resin: namely, about 90 parts in 100; whereas stick lac contains not more than 68.

MASTICH, OR GUM MASTICH.

Mastich is a *resin;* by which is understood a friable inflammable substance, more or less odorous, soluble in whole or in part in rectified spirit of wine, and insoluble in water. Mastich is in small transparent drops, or tears, of a lemon colour. It exudes by incision, or even without incision, from the bark of the *pistacia lentiscus,* or mastich tree, native of the Levant. It is most abundantly obtained in the island of Chios. This resin readily melts over the fire; it has a sweet and slightly aromatic smell, with a weak balsamic savour.

Mastich is occasionally confounded with gum sandarac: from the last, however, it may be easily known, as it is always in round transparent tears, while those of

sandarac are long, less transparent than mastich, and have a terebinthine smell. Besides mastich readily dissolves in rectified spirit of wine, which exercises a weaker action on sandarac. Mastication, for which this substance is reserved in the Levant, affords a second means of distinguishing these two resins; mastich under the teeth becomes pliable, and may be drawn out in the form of a cord; but sandarac separates into small grains, and has a bitter taste, which is not found in mastich.

This resin gives toughness to varnish, and sufficient hardness to bear polishing. Compositions in which it does not enter are incapable of enduring that operation.

GUM ANIME.

There are two kinds of this resinous substance: one found in the East, another in the West, which comes in particular from Brasil. The former has a sweeter odour than the other, which is more common in commerce. It is the product of the roots of the *hymenæa coubaril*, or Leathery-leaved locust tree, a native of the West Indies, as well as of other parts of America.

The best pieces are of a pretty large size: they appear marbled with white, opake, and yellow transparent veins. This substance has a sweet and agreeable smell. Externally it oftens exhibits the same appearance as copal; but it is more brittle, less solid, and melts more readily over the fire, or while burning emits a bright flame: it is wholly soluble in rectified spirit of wine, and also in oil. Its use in the composition of varnish is nevertheless very limited. It forms part of

the least drying spirit varnishes. When treated alone with that liquor it does not unite into a mass, even though subjected to a balneum mariæ; and it always remains in a pulverulent state. This residuum, however, which continues insoluble when there is no mixture, dissolves in part in spirit, when mixed with other resins that are soluble. It communicates to varnish an agreeable odour, which renders it proper for being employed on articles belonging to the toilette. It ought to be chosen new, and exceedingly pure; which may be known by the quantity of the transparent parts.

GUM ELEMI.

The resin, erroneously called *gum elemi*, is said to be the product of the *amyris elemifera*, or elemi tree, a native of Carolina and the Brasils. But it used to be brought from Turkey. It appears to be similar in its properties to the turpentines. It is in masses similar to that in which we find the crude turpentines; it hardens by age and exposure to the air. It emits a strong odour, which has been compared to that of fennel: it is almost entirely soluble in rectified spirit of wine. It has a yellowish green colour, and is interspersed with some reddish veins or glands. It has a solid consistence, but becomes soft under the fingers. The elemi obtained from Ethiopia is said to be the best.

GAMBOGE.

Gamboge is a gum resin obtained from the *stalagmitis cambogioides*, or Gamboge tree, a native of Siam and the

island of Ceylon, by wounding the bark, whence issues a juice, which being received into proper vessels, becomes by desiccation dry, solid and compact, hard, opake, and inflammable, and of a yellow colour, inclining a little to red. A greater quantity of it is taken up by spirit of wine than by water.

It imparts a very beautiful yellow colour, which renders it exceedingly proper for water colours. In this respect it is used for washing and for miniatures. It possesses a colouring principle, much sought after for giving a gold colour to the compositions of changing varnishes. It communicates to them also body and brilliancy.

It ought to be smooth and brilliant on the fracture, and of an orange yellow colour, without impurities. It has a kind of vitreous appearance. It is a violent purgative, and therefore should not be admitted into the mouth or stomach.

SANDARAC, GUM SANDARAC, OR GUM JUNIPER.

Gum sandarac was formerly supposed to be the produce of the common juniper, or the *juniperus oxycedrus*, or Brown-berried juniper, a tree growing in Spain, and some parts of Africa; but modern botanists say that it is obtained from a species of arbor-vitæ, the *thuja articulata*. It is in the form of tears, sometimes elongated, sometimes round, and sometimes folded together. That most esteemed is bright, shining, semi-transparent, and of a pale yellow colour. It has a balsamic odour, and a somewhat acrid taste, although sandarac is not difficult

to be distinguished, fragments of copal and other substances are sometimes fraudulently substituted in its stead.

It is soluble in rectified spirit of wine, in essential and fixed oils*, but less so than mastich. By this union, and particularly by that with spirit of wine and oil of turpentine, it forms a varnish which possesses great splendour; but it is soft, and easily scratched by the least friction. The varnish, however, may be rendered harder by mixing the sandarac with other resinous substances not so dry, such as elemi or anime. It is one of the bases of spirituous varnishes.

DRAGON'S BLOOD.

Dragon's blood is a dry, friable, inflammable resin, of a dark red colour. When in large thin laminæ it is transparent. It has neither savour nor smell when cold; but when burnt it emits a balsamic odour.

Of the origin of this resin different accounts are given; some say it is obtained from the fruit of the *calamus rotang*, a species of cane growing in the East Indies; others assert that it is the inspissated juice of the *pterocarpus santalinus*, or red Saunders' tree: there is, however, good reason for believing that it is obtained from many Indian trees, which produce a blood red juice; but chiefly, we believe, from the *pterocarpus draco* and the *calamus rotang*.

* When it is necessary to unite it to drying oils, the same process must be employed as that used for the preparation of amber and copal varnish.

There are several kinds of dragon's blood. That most esteemed comes to us in drops of the size of an olive. It is, however, more commonly found in balls and other masses. The best is that which dissolves most completely in rectified spirit of wine. That of inferior quality does not inflame; such is improper for varnishes.

Real dragon's blood readily unites with rectified spirit of wine, and with essential and drying oils: it is, however, employed only for spirituous varnishes, or those made with essential oils, and particularly when it is required to make a changing varnish designed for foil or tinsel, or for gilt leather.

RED SAUNDERS, OR RED SANDAL WOOD.

We may just state here, that the colouring matter of the wood of the *pterocarpus santalinus*, mentioned in the preceding article, is taken up by spirit of wine, and therefore it may be employed in colouring spirit varnishes.

ALKANET ROOT.

The root of the *anchusa tinctoria*, a native of the south of Europe, will also yield its red colouring matter to alcohol and ether, as well as to expressed oils; it may be therefore employed as a colouring material in varnish.

AMBER.

Amber is found plentifully in Prussia; it is also obtained in some other parts of Europe; occasionally on the sea coast, in various countries; and in some gravel

beds near London. It is of all colours, but chiefly yellow or orange; it is also sometimes exceedingly transparent, and often contains leaves or insects. It is dry, brittle, and inflammable, yet hard, and susceptible of a fine polish; although it has the properties of a bitumen, it was probably once a vegetable product. When rubbed on woollen cloth it exhibits an electric property: the ancients called it *electrum*.

Amber does not unite indiscriminately with all alcoholic liquors, or with all the different oils usually employed in the composition of varnishes. It would even resist fat drying oils, if the preliminary preparations which convert it into varnish were neglected; essential oils exercise very little action on it. It does not dissolve in ether.

Rectified spirit of wine distilled in a balneum mariæ over amber dissolves a portion of it, and when the first portions of the spirit distilled, are re-distilled several times over the powder contained in the balneum mariæ, it forms a kind of varnish.

Amber designed for the composition of varnish must be chosen pure, transparent, and without any mixture of foreign bodies.

TURPENTINE.

Turpentine is the inspissated juice of several species of the *pine*. It often exudes spontaneously from the tree, but is more commonly obtained by incisions made for the purpose. It is found in the shops of this country under various names. *Crude* or *unstrained turpentine*

is imported in casks from various countries, chiefly at the present time from North America. This article, hardened by age, is the FRANKINCENSE of the shops.

Turpentine is distinguished in commerce into *Chio*, *Venice*, *Strasburgh*, and *common*, *strained* or *horse turpentine*, besides the *crude* or *unstrained* before mentioned.

TURPENTINE OF CHIO.

Turpentine of Chio is obtained from the *pistacia terebinthus* or turpentine tree, a native of the south of Europe, and growing also in the islands of Chio and Cyprus. It is of the consistence of thick honey, of a whitish yellow colour, and semi-transparent. It has a strong balsamic odour, and moderately warm taste. This kind of turpentine is the rarest and most esteemed. It may be employed in small quantities in the least drying kinds of varnish, that is to say, in those which admit the union of gum elemi, gum anime, &c.

VENICE TURPENTINE.

Venice turpentine is obtained, it is said, from a kind of larch, very abundant in the Apennines. It is fluid, limpid, glutinous, tenacious, and of a consistence between that of oil and that of honey. It has a yellowish white colour, and a strong penetrating yet agreeable smell, inclining somewhat to that of oranges. It possesses a more acrid and bitter taste than the turpentine of Chio. When pure, this turpentine is useful as a

body for varnish; but it is scarcely possible to be obtained genuine in this country.

See forwards TURPENTINE VARNISH, and artificial VENICE TURPENTINE.

TURPENTINE OF STRASBURGH.

The turpentine of Alsace, or of Strasburgh, is produced by a kind of silver fir. When fresh it is liquid, and more transparent than that of Venice, but less viscid and tenacious. Its smell is very agreeable.

This turpentine also is exceedingly proper for varnish; but it gives less body to the composition than that of the larch. In general, the addition of turpentine to varnish contributes to give it a great deal of splendour, but does not render it more durable.

COMMON, STRAINED OR HORSE TURPENTINE.

This is reserved for less valuable purposes, and ought not to be employed in the composition of varnish. There is great reason for believing that this turpentine, which is prepared for sale in this country, is mixed with some glutinous oil, and is therefore unfit for the composition of varnish.

OIL OF TURPENTINE

Is distilled from crude turpentine with a certain portion of water to moderate the heat. We shall say more concerning this vehicle for varnishes in the next chapter.

YELLOW RESIN—BLACK RESIN.

When turpentine is distilled with water, the residuum, which cannot be volatilized, remains mixed with the water in the still, and constitutes what is known by the name of yellow resin. It is separated from the water, and, being left to drain, is again melted before it is made an article of commerce.

Black resin is merely yellow resin deprived of more of its oleous matter by a still greater degree of heat.

GALLIPOT—BARRAS.

These express rather the state of purity and consistence of the resinous substance furnished by the pine than any essential difference in its nature.

The name *barras* expresses the soft resin which adheres to the bark of the tree, and which often contains fragments of it, as well as dust and sand conveyed to it by the wind. It is sometimes seen resinified by the action of the air and of the sun.

The word *gallipot* denotes the same substance, but in a state of purity, in consequence of the care taken when it distils to convey it into wooden troughs placed at the bottom of the trees, or into pits lined with fat earth. This matter is viscous.

BURGUNDY PITCH.

Burgundy pitch is obtained by incisions made through the bark of the *abies communis*, or Norway spruce fir, a

native of several countries in the north of Europe; the flakes of terebinthine matter, after being separated from the tree, are put into boilers with water, melted and strained through cloths by pressure. It is obtained in large quantities in the neighbourhood of Neufchatel, whence it is brought to this country in tubs. It is sometimes, nay, in England, often adulterated with yellow resin. The genuine may be known by being of a reddish colour, and yielding on pressure a portion of water, and also being by far less brittle than the adulterated kind.

TURMERIC ROOT, OR TERRA MERITA.

Turmeric root, or terra merita, is the root of the *curcuma longa*, or long-rooted turmeric, which grows in great abundance in every part of India, and which is carefully cultivated by the Indians.

Turmeric root is also a West Indian production. It should be chosen hard, compact, having a resinous fracture, and free from worms. This root is very much used in dyeing. It is, however, found in general that it is inferior to woad, both in regard to duration and to colour; but dyers prefer it in the use which they make of yellow, in dyeing scarlet, to heighten the colour of the cochineal or kermes, of which they compose the dyeing liquor. It is employed in varnishing only under the form of a tincture. It enters into the mixture of those colouring parts which contribute the most to give to metals the colour of gold.

CHAPTER III.

Of the Fluids which serve as vehicles for Varnishes.

VEHICLES FOR VARNISHES.

THE liquids chiefly employed in the art of varnishing, are *rectified spirit of wine*, *ether*, *oil of turpentine*, and *essential oil of lavender*. These liquids are exceedingly light and volatile; besides these and *water* for the solution of the pure gums, such as gum arabic and gum tragacanth, the varnisher employs other liquids more fixed; of this kind are *fat or fixed oils*, such as *oil of poppy*, *nut oil*, and *linseed oil*. The unctuous nature of the latter would prevent the drying of varnish, unless a drying quality were imparted to them by being *boiled*, or otherwise treated with certain bodies which confer upon them *drying* qualities; thus modified they become the most convenient vehicles for every kind of varnish designed for covering bodies exposed to percussion, to friction, and to the influence of the weather.

RECTIFIED SPIRIT OF WINE—ALCOHOL.

Spirit of wine is obtained by the distillation of wine, and of other saccharine substances which have under-

gone the vinous fermentation. By this operation it is procured of different degrees of strength. The first distillation gives a weak spirit. Repeated distillation, with alkaline salt or other matter to arrest its aqueous and oleous particles, at length produce rectified spirit of wine. In this state it is a light, transparent, colourless and highly inflammable fluid, and contains usually about five parts in 100 of water; when wholly deprived of water, it is called *alcohol.* The specific gravity of rectified spirit of wine is 835, distilled water being 1000; of alcohol, 796.

The best methods to determine the choice of this article are these: the *hydrometer*, and *taking the specific gravity*, attending at the same time to the temperature, which ought to be from 55° to 60° of Fahrenheit. It may however be stated that a wine pint of rectified spirit of wine should not weigh more than $13\frac{1}{2}$ ounces avoirdupoise.

This circumstance should be carefully attended to: for spirit of wine dissolves resinous bodies proper for varnish, only in proportion to its strength.

Spirit of wine may be of use also in the art of varnishing, in consequence of its dissolving certain colouring matters; but these colouring parts alone do not always constitute varnish: besides, in regard to this use, their number is very small, since it is confined to one species; that is, the changing varnishes. Another spirit of wine, called *proof spirit*, is also occasionally employed in the solution of some gum resins: it contains of alcohol 55 parts, and of water 45 parts in 100: a wine pint of it

weighs about 15 ounces. It is usually obtained by merely mixing rectified spirit of wine and water in the proportions here stated; it is, however, rarely used in varnishes.

SULPHURIC ETHER.

Ether, like spirit of wine, is an artificial production. The method of obtaining it is described in most chemical books. It is colourless, transparent, exceedingly volatile, has an agreeable odour, different from that of spirit of wine, and a penetrating savour, but not hot and irritating like that of alcoholic spirit: in fact, it imparts, on being tasted, a peculiar coldness to the tongue. By repeated shaking, a part of it may be united to water; but the rest floats on the surface of the water as pure oil would do.

Its action on resins is not so extensive as that of rectified spirit. A mixture of the smallest portion of extractive, gummy, or mucilaginous matter is capable of weakening its energy on the resinous part, whatever may be its quantity. The application of it is not successful but with pure resins. In this case it becomes an agent very much superior to spirit of wine, and to every other fluid. Copal, the characters of which seem, in some respects, to be confounded with those of amber and caoutchouc, attest, in this respect, the superiority of ether to spirit of wine.

I confine the employment of this volatile liquor to the composition of copal varnish, and by addition to that of caoutchouc varnish. It might indeed be applied to the

composition of other kinds, but the dearness of it will always prevent its use in common varnishes.

OIL OF TURPENTINE

Is an essential, colourless, limpid, light, volatile, and inflammable oil, extracted from turpentine by distillation. Its specific gravity is only 792. The lightest and the least coloured is that which ought to be employed for varnish.

It is sometimes, although we believe rarely, mixed with fat oil: in this case its use would be hurtful in the preparation of varnish: for fat oil renders varnish unctuous, glutinous, and difficult to dry.

The adulteration by fat oil may be also thus detected: impregnate a bit of paper with this oil, and hold the paper before the fire. Pure oil of turpentine will evaporate completely, without leaving any traces on the paper, on which you may afterwards write. If it be mixed with fat oil, the paper will remain transparent, and refuses every impression of writing.

The best spirit of wine can take up no more than a third of its weight of common oil of turpentine, and a seventh or an eighth part of the lightest; but it dissolves in *hot* alcohol, and separates from it again as the spirit cools.

What is called *ethereal oil of turpentine*, is rarely, if ever met with in the shops. If a peculiarly pure oil should be wanted, it may be obtained by submitting common oil of turpentine to another distillation.

ESSENTIAL OIL OF LAVENDER.

The varnisher has not much occasion to make use of this oil, which is better known to the enameller, because it has sufficient consistence to prevent the colours diluted with it from running under the brush.

Besides this advantage, which is not to be found in oils that are too fluid, it retains a sort of unctuosity, which prevents the inconvenience of too speedy desiccation. It is on account of this quality that it is most interesting to the varnisher. It is indeed employed in the composition of mordants, to which it communicates a sufficient degree of unctuosity to give the painter time to sketch out the design, which the gilder afterwards fills up.

This essential oil is extracted by distillation from the flowers or tops of lavender, the *lavandula spica*, a plant well known in our gardens, and a native of the south of Europe: two or three varieties are called *spike*. The calyx of these flowers contains a great deal of this oil, which is volatilized in vapour with the water, at the temperature of boiling water, and which is afterwards separated from the water, over which it floats.

This oil is sometimes adulterated with that of turpentine, more frequently with *oil of rosemary*, and hence difficult to be detected, except by its impure smell. Another kind of adulteration is practised by mixing it with fat oil, such as oil of poppy, &c. For the means of detecting this adulteration, see OIL OF TURPENTINE.

The best oil of lavender is that obtained from the

flowers in this country, and known in commerce as *English oil of lavender.*

OIL OF ROSEMARY.

This essential oil may also be mentioned here, as a solvent of copal, by the assistance of heat, as well as oil of lavender. It is probable that both these oils dissolve copal in consequence of their containing a portion of camphor.

OIL OF WHITE POPPY SEEDS.

The oil extracted from the seeds of the single white poppy, *papaver somiferum*, by contusion and expression, is exceedingly sweet, unctuous, and nearly colourless, and, therefore, much used for delicate purposes. It acquires a drying quality by age alone; but several methods are employed to give it this necessary disposition: the following is one of the best.

Process for giving a drying quality to Oil of Poppy.

Into three pounds of pure water put an ounce of white vitriol, and mix the whole with two pounds of oil of white poppy seed. Expose this mixture in an earthen vessel capable of standing the fire, to a degree of heat sufficient to maintain it in a slight state of ebullition. When one-half or two-thirds of the water has evaporated, pour the whole into a large glass bottle, or jar, and leave it at rest till the oil becomes clear. Decant the clearest part by means of a glass funnel, the beak of which is stopped with a piece of cork: when the sepa-

ration of the oil from the water is completely effected, remove the cork stopper, and supply its place by the fore-finger, which must be applied in such a manner as to suffer the water to escape, and to retain only the oil, which, when prepared in this manner, becomes, after some weeks, exceedingly limpid and colourless.

Remarks.

Many artists reject every preparation of oil in which water has been employed as an intermediate substance. The drying material may, it is true, be *boiled* with the oil without water; but as the heat administered to the oil will be so much greater, the probability is that more or less colour will be added to it, and consequently, for delicate colours, the oil will be totally unfit. In the process here given, the oil becomes charged with a little water, by which it acquires a nebulous appearance, and retains it for several weeks. This interposed water gradually separates itself from it, and at the same time carries with it a mucilaginous matter, a little altered; the complete separation of which adds to the extreme purity of the oil. Perfect limpidity is the surest sign of the absence of all its foreign particles. A slight heat accelerates the clarification of oil prepared with water.

NUT OIL.

Nut oil is extracted by contusion and expression from the kernels of several kinds of nuts, chiefly from walnuts or hazel nuts, either with or without heat. That obtained by heat is the most proper for the varnisher

and the painter. But, although it is preferable on many accounts, to linseed oil, in this country it is not a common vehicle; and if oil be sold as nut oil, there is much reason to fear that some other oils supply its place.

LINSEED OIL.

This oil is obtained from the seeds of the *linum usitatissimum*, or flax plant, (an annual cultivated in almost every part of Europe, as well as in this country,) by contusion and expression: for medical use *without*, but for the painter and varnisher *with* the aid of considerable *heat*. Of all the fat oils, this requires the greatest heat in its extraction; it is therefore always more or less coloured and thick. It is the principal oil employed in this country by the painter; it is also occasionally used by the varnisher. In order, however, to its becoming more fitted for the use of both these artists, it is usually subjected to one of the operations described below, to give it a *drying* quality.

Of linseed oil this general observation may be made, that it acquires by age alone considerably more tenacity than it has when first expressed from the seed, and is therefore in itself more disposed for drying than when in a recent state: indeed, *gold size* is frequently directed to be prepared with such old oil in preference to any other.

METHODS EMPLOYED TO GIVE TO FAT OILS A DRYING QUALITY.

First Process.

Take of nut oil or linseed oil, 8 pounds.

White lead slightly calcined,
Sugar of lead also calcined,
White vitriol, - - - - } of each 1 ounce.

Litharge, 12 ounces.

A head of garlic, or a small onion.

When these matters are pulverized, mix them with the garlic and oil over a fire capable of maintaining the oil in a slight state of ebullition: continue it till the oil ceases to throw up scum, till it assumes a reddish colour, and till the head of garlic becomes brown. A pellicle will then be soon formed on the oil; which indicates that the operation is completed. Take the vessel from the fire, and the pellicle, being precipitated by rest, will carry with it the more unctuous parts. When the oil becomes clear, separate it from the deposit, and put it into wide mouthed bottles, where it will completely clarify itself in time, and improve in quality.

Second Process.

Take of litharge, $1\frac{1}{2}$ ounce.

White vitriol, $\frac{3}{8}$ of an ounce.

Linseed or nut oil, 16 ounces.

The operation must be conducted as in the preceding case.

A little negligence in the management of the fire has often an influence on the colour of the oil. This inconvenience may be avoided by tying up the drying matters in a small bag; but the dose of the litharge must then be doubled. The bag must be suspended by a piece of packthread fastened to a stick, which is made to rest on the edge of the vessel in such a manner as to keep the bag at the distance of an inch from the bottom of the vessel. A pellicle will be formed, as in the first operation, but it will be slower in making its appearance.

In this process the oxide of lead, when it is free, and when it rests on the bottom of the vessel, is in a great part reduced. Small grains of lead even are often observed in it.

The previous calcination recommended for certain matters, without specifying the reason, as for ceruse and salt of lead, is to be considered here only in a practical point of view, as a mere precaution in the process. When these matters are employed without previous calcination, it will be proper not to add them to the almost boiling oil, but in small separate portions.

In all cases where preparations of lead are employed for freeing oils from their greasy principles, great care must be taken not to stir the mixture too much with a spatula, because the oil then becomes charged with the lead, and combining with it, retains it under the form of soap. The oil is thus rendered exceedingly thick, and assumes the consistence of jelly. It will be sufficient to leave the mixture to itself over a gentle fire, capable of making the liquid enter into a slight degree of ebullition.

The garlic is employed merely for the purpose of indicating the moment when the whole aqueous part of a mixture is evaporated.

Drying oil is employed for several purposes. When colourless it is much sought after by those who paint pictures. It enters into the composition of varnish, and it serves itself as varnish in oil painting, either employed alone, or diluted with a little oil of turpentine. When designed for house painting, it will be advantageous to use, for the last coating, *resinous drying oil*, which exhibits all the qualities of a varnish. Its preparation is as follows :—

RESINOUS DRYING OIL.

Take 10 pounds of drying nut oil, if the paint be designed for external articles, or 10 pounds of drying linseed oil, if for internal.

Yellow resin 3 pounds.

Common turpentine 6 ounces.

Remarks.

Melt first the resin by a gentle heat, to which add the turpentine, and lastly, the oil, so as not to coagulate the resin ; leave the varnish at rest, by which means it will often deposit portions of resin and other impurities ; preserve it in wide-mouthed bottles. It must be used fresh : when suffered to grow old, it deposits some of its resin. If this resinous oil become too thick, dilute it with a little oil of turpentine, or with oil of poppy, if intended for articles sheltered from the sun.

In general, every first coating with oil applied to a wall, ceiling, &c. ought to be exceedingly warm, to harden the surface which is to receive the painting.

Third Process.

A drying quality may be communicated to oil by treating in a heat capable of maintaining a slight ebullition linseed or nut oil, to each pound of which are added three ounces of litharge reduced to fine powder.

Fourth Process.

Take of nut oil, 2 pounds.
Common water, 3 pounds.
White vitriol, 2 ounces.

Mix these matters, and subject them to a slight ebullition till little water remain. Decant the oil, which will pass over with a small quantity of water, and separate the latter by means of a funnel. The oil remains cloudy for some time ; after which it becomes clear, and seems to be very little coloured. The oil is rendered somewhat less drying than by the other processes, and is attended with this inconvenience, that it remains cloudy for a very long time, even when exposed to the influence of the sun.

Fifth Process.

Take of nut or linseed oil, 6 pounds.
Common water, 4 pounds.
White vitriol, 1 ounce.
One head of garlic.

Mix these matters in a large iron or copper pan ; then place them over the fire, and keep the mixture in a state of ebullition during the whole day : boiling water must from time to time be added, to make up for the loss of that dissipated by evaporation. The garlic will then assume a brown appearance. Take the pan from the fire ; and having suffered a deposit to be formed, decant the oil, which will clarify itself in the vessels. By this process the drying oil is rendered somewhat more coloured : it is reserved for delicate colours.

Remarks.

This method is one of those which require the utmost attention ; and, therefore, by some it has been condemned. If the water mixed with the ingredients, and that added in a state of ebullition during the process, to supply the loss of that dissipated by evaporation, be too abundant, and if towards the end of the operation it be not all dissipated, it will unite with the drying oil, and communicate to it the colour and the consistence almost of cream. In this case the oil will clarify slowly ; there will even remain an interposed portion, which it will be difficult to separate. This inconvenience seems to justify the censure passed by some artists on this process. However, when well conducted, it affords a very simple method of obtaining oil exceedingly drying, and much less coloured than that subjected to the direct impression of the fire ; but it requires to be kept for some time.

In the preparation of oil of poppy, it has been seen

that water is added, by the evaporation of which the temperature is kept at a fixed point, and hence the oil undergoes no decomposition. By varying the process, it may be rendered the sole cause of the drying quality required to be given to a fat oil. Water in the state of snow will exhibit the two conditions essentially necessary to produce this effect. It is on this principle that the following process is founded:—

Sixth Process.

When the long continued cold of winter gives to snow a pretty dry consistence, take linseed oil, nut oil, or oil of poppy, any quantity, and mix it with snow, kneading the mixture in a bason with a wooden spatula, or in a mortar with a pestle. Form it into a solid mass, and place it in an earthen, a glass, or a porcelain vessel, with a large aperture, and cover the aperture with a cloth to prevent the introduction of foreign bodies. Expose the vessel in a place accessible to the cold, but sheltered from the influence of the solar rays. On the return of a milder temperature the snow will dissolve into water, which will separate itself from the oil, with the impurities of which the water will be charged. If a severe temperature continue two months, the oil will acquire in a high degree, its drying quality.

The oil is decanted from off the water, or it is removed with a spoon, and put into a bottle. Rest, by separating the interposed particles of water, is sufficient to clarify it. This separation may even be accelerated by exposing the oil to the heat of a balneum mariæ.

Modification of the same Process.

If an oil, already rendered drying, by one of the preceding operations, be employed in this process with as few reacting ingredients and as little heat as possible, the oil becomes drying in an eminent degree. It is then very thick, and a part of it is so mixed with the water, that the result is a glutinous and almost resinous matter, which adheres so much to the interposed liquid, that it obstinately retains that form, whatever process may be employed to break the union of the water and the oil. But in treating oil of hemp seed in this manner, the separation of two very distinct oils has been observed; one of which, having a greater specific gravity than water, fell to the bottom of the vessel, while the other occupied the upper part in such a manner, that the whole of the liquid produced by the melting of the snow formed an intermediate stratum between these two oils.

The first, that is to say the heaviest, was very little coloured: it was less so than the second, and even than the oil of hemp seed itself was before its mixture with snow. The first stratum of oil formed two zones, the upper one of which was clear; the other was opake, and of a chamois colour. The latter, which retained water, was exceedingly thick, and as if resinified. The water which served to separate these two kinds of oil was cloudy. In general its present state depends on the greater or less purity of the oil employed, and on that of the snow.

The heaviest oil, and that found the least coloured, may be used for the preparation of paste made with white lead or Cremnitz white, employed to repair broken enamel.

DRYING OIL FOR PRINTERS' INK.

Printers' ink is a real black paint, composed of lamp black and linseed oil, which has undergone a degree of heat superior to that of the different drying oils already mentioned. A greater or less consistence is given to it, according to the strength of the paper; and this depends on the degree of heat given to the oil, or on the mixture of a greater or less dose of lamp black.

The degree of heat applied to the oil is sufficiently great to decompose it in part, and even to make it inflame. Should this prepared oil retain unctuosity, it would fill the eye of the letter, run upon the paper, and communicate to it a semi-transparency of a yellow colour. This effect is particularly striking in works printed with bad ink.

The preparation of this ink is simple: boil linseed oil for eight hours in a large iron pot, and add to it bits of toasted bread, to absorb the water contained in the oil. Leave it at rest till next morning, and then expose it eight hours more to the same degree of heat, or until it has acquired the necessary consistence: then add lamp black worked up with a mixture of oil of turpentine and common turpentine. This operation is to be performed in the open air, to prevent the bad effects of the vapour of the burnt oil, and, in particular, to guard against accidents by fire.

See some further observations on this subject in our TREATISE ON PAINTING, p. 167.

To the preceding processes, which were all described in the former editions of this work, the following may also be added.

"The most simple process of preparing drying oil is by boiling it for a considerable time without any addition."—WHITTOCK, page 17. *See the next note.*

This process, as well indeed as most of the preceding processes, is one which ought to be carefully performed: for as expressed oil requires a considerable heat before it will boil, namely, about 600 degrees of Fahrenheit's thermometer, there is danger, when it is brought to such a heat, that it may explode; or, at any rate, give out an inflammable gas, which will take fire if exposed to any flaming body, such as a candle.

"A drying quality may also be given to linseed oil, and its colour much improved, *without boiling*, by mixing about one pound of white lead with a gallon of oil, and letting it stand a week or two, till the lead and the feculent parts of the oil have sunk to the bottom of the vessel. This is a cheap way of purifying oil, as the lead can always be used for common purposes *."

* See WHITTOCK's *Decorative Painter's and Glazier's Guide*, a work in *one volume, quarto,* containing numerous well-coloured and explanatory plates; a work which neither the *decorative painter*, *glazier*, nor even the *varnisher*, should be without: a work, whose copiousness of detail, and accuracy of *practical* information, on the various subjects of which it treats, has no rival; here the *painter*, the *varnisher*, the *glazier*, and the *glass-stainer*, will find, what we believe no other book contains, namely, directions for the *practical application* of their respective arts,—EDITOR.

CHAPTER IV.

General observations on Varnishes, with a distribution of them into five genera, and directions for their several preparation.

THE art of the varnisher comprehends three essential parts:

1st, Composition.
2d, Application.
3d, Polishing.

Composition.

This part is confined to resinous, inflammable substances, which have a certain analogy to some spirituous liquors, in consequence of which they are disposed to unite with each other.

None of the compositions known are indiscriminately proper for all purposes; because a certain concordance ought to exist between the varnish and the article to the decoration of which it is intended to contribute. The varnisher finds it sometimes convenient to retard the de siccation of his composition, that proper time may oe left to the designer to delineate, and even to detail his subjects. In other cases, he endeavours to give to the

bodies which he covers with his compositions a solidity capable of opposing a certain resistance to percussion and to friction.

These circumstances, which are well known to all persons acquainted with the details of this art, render it necessary to have compositions of various kinds, which it will be proper to treat of separately.

Application and Polishing.

The two other parts which constitute the art of the varnisher, relate more directly to the artist than to the amateur. They require more experience than study. The application and polishing of varnish require practice. The precepts, however, which are applied to this part, present no difficulty which may not be surmounted by an intelligent and skilful amateur.

The composition of varnish depends on the property of solubility, in which several substances participate, but with modifications depending on their particular nature. These substances, however, when thus united, exhibit mixed properties, much superior to those they possess individually, and which concur to produce results that are sought for in the common kinds of varnish: that is to say, speedy desiccation, lustre, and solidity.

Notwithstanding *resins* appear, at first sight, to possess similar properties, they exhibit, nevertheless, very striking differences, particularly when employed in the composition of varnish; hence the necessity for the various formulæ which are given in this work. Certain varnishes

possess a drying quality in an eminent degree : these are the least durable. Others are glutinous, fat, and long in drying ; but these are the strongest when they have become sufficiently dry. Some hold an intermediate rank between these two kinds ; they have, therefore, a mean quality between those varnishes the most exposed to accidents, and those which present the greatest resistance to the impressions and friction of hard bodies.

A careful observation of these differences induced the authors who have written on the art of varnishing, to distinguish them by a classification, founded on the nature of their composition, and on the uses for which they are destined.

I have thought it my duty to follow the same order. It has the advantage of exhibiting each varnish accompanied, in some measure, by its particular properties, and of enabling artists to refer known compositions, and such as may afterwards be invented, to one of the genera or species determined by the order and nature of their component parts. This division also indicates the case in which they may be employed, and the mode of using them.

DIVISION OF VARNISHES.

Two classes of varnish, divided into genera and subdivided into species, may be admitted in this work. The first class comprehends the varnishes used for objects of natural history, the genera of which are borrowed from that of the substances employed, and which may belong to the vegetable kingdom, as the solution of a pure gum-

such as gum arabic; or to the animal kingdom, such as isinglass.

The second class, which is the principal object of this work, comprehends the varnishes made by a solution of one or more resinous substances in a spirituous or oily vehicle. It will be exceedingly convenient to divide it into five genera, each of which has its proper species.

The *first* genus comprehends the most drying varnishes that can be obtained with spirit of wine.

The *second* genus presents formulæ for varnish nearly similar to those of the first; but they are of a less drying nature, in consequence of the use of less drying resins. This second genus gives different species of changing varnish, which do not require so much solidity as those designed for glazing metallic surfaces.

The *third* genus is reserved for compositions in which the nature of the solvent is changed. Spirit of wine here gives place to essential oils, and in particular to oil of turpentine. This class ought to comprehend changing varnishes, and those distinguished by the name of *mordants*.

The *fourth* genus is designed for the employment of pure copal treated with oil of turpentine, and even with ether. These varnishes vie, in point of solidity, with those of the following genus, and ought even to be preferred to them.

The *fifth* genus admits of fat, drying oils being employed as the solvent. It contains the fat varnishes made with copal, with amber, and with caoutchouc.

Their colour, which is pretty dark, confines the use of them to grounds of a dark colour.

Each composition will be accompanied with particular remarks relating to the process; to the nature and qualities of the varnish; and to the circumstances most favourable for its application.

DRYING VARNISHES MADE WITH RECTIFIED SPIRIT OF WINE.

First species.

No. I.

Take of rectified spirit of wine, 32 ounces.
Gum [1] mastich, 6 ounces.
Gum sandarac, 3 ounces.
Very clear Venice turpentine, 3 ounces[2].
Glass coarsely pounded, 4 ounces.

Remarks.

Reduce the mastich and sandarac to fine powder; mix this powder with white glass, from which the finest

[1] In the former editions of this work *purified* mastich was directed; but it is thought better to direct *gum* mastich; as it is concluded that whoever should make varnish from any of these formulæ will take care to obtain the best and purest of the respective articles.—EDITOR.

[2] It should be noted here, and also in regard to all the spirit varnishes described in the subsequent portions of this work, that the *Venice* turpentine sometimes found in the shops, contains a certain portion of some expressed oil, usually linseed oil, and that such turpentine is not proper for *spirit* varnishes; care should be, therefore, taken not to employ it.—EDITOR.

parts have been separated by means of a hair sieve; put all the ingredients with the spirit into a short-necked matrass, and adapt it to a stick of white wood, round at the end, and of a length proportioned to the height of the matrass, that it may be put in motion. Expose the matrass in a vessel filled with water, made at first a little warm, and which must afterwards be maintained in a state of ebullition for one or two hours. The matrass may be made fast to a ring of straw.

The first application of the heat tends to unite the resins into a mass: this union is opposed by keeping the matters in a state of rotary motion, which is easily effected by means of the stick, without moving the matrass. When the solution is complete, add to it the turpentine; after which the matrass must be left in the water for half an hour, when it must be taken out; and the varnish continually stirred till it is somewhat cool. Next day it is to be drawn off, and filtered through cotton. By these means it will become exceedingly limpid. This simple process is sufficient for the composition of all those varnishes which form part of the first four genera, unless it is necessary to operate on a large scale. Many amateurs are satisfied with simple digestion for such varnishes, taking care to stir the mixture often. This method, which may be proper for varnish composed with spirit of wine, would be too slow for varnishes of the third and fourth genera. In general the digestion is terminated by some hours' exposure to the sun; with the precaution of renewing the surfaces by stirring the ingredients with a clean rod. Or the

vessel containing the ingredients to form the varnish may be conveniently placed in a moderate *sand-heat:* of course they should be occasionally stirred.

The glass directed to be used merely divides the ingredients of the mixture, and thus facilitates the solution of the resins in the spirit; besides which, as its weight exceeds that of the resins, it prevents them from adhering to the bottom of the matrass; it also prevents the discolouration of the varnish when a sand-heat is employed, as is commonly the case.

The best spirit of wine rarely becomes charged with more than a third of its weight of the resinous substances subjected to its action. A particular examination of several kinds of varnish, of a proper consistence, never indicated a greater increase than a fourth part of the weight of the spirit employed.

When too large a quantity of matter, therefore, is added to spirit of wine, the latter seizes on the most soluble parts, and has very little effect upon those which are less so. The dry parts of the resin escape the action of the liquid if only a moderate heat be employed. In this case the varnish has very little colour; but if it seems to gain in pliability, it loses in consistence and solidity. It is of great advantage to unite all these three characters at the same time; and this may be accomplished by limited proportions, and by employing a little more time and pains in the process.

The varnishes which constitute the first genus are employed for the most part to supply the place of glazing. They are brilliant, but do not all possess the

same degree of solidity. The first species exhibit more pliability than consistence or body. The application of them is suited to articles belonging to the toilette, such as dressing-boxes, cut-paper works, &c. The next species possess the same brilliancy and lustre; but they have more solidity, and are exceedingly drying.

Second species of varnish of the same genus.

No. II.

Take of pounded copal of an amber colour, once liquefied according to the method to be hereafter described, 3 ounces.
Gum sandarac, 6 ounces.
Gum mastich, 3 ounces.
Clear turpentine, $2\frac{1}{2}$ ounces *.
Pounded glass, 4 ounces.
Rectified spirit of wine, 32 ounces.

Mix these ingredients, and pursue the same method as that directed for No. I.

Remarks.

The opinion generally entertained of the insolubility of copal in rectified spirit of wine, might inspire some doubt in regard to the employment of this matter; but, never-

* In this and the subsequent formulæ for varnishes, as given by M. Tingry, it has been thought most advisable to retain the expression *clear* turpentine, although it is not easy to ascertain what turpentine is meant. The purest common turpentine, as turpentine, will be, doubtless, found that which is called in this country *frankincense*. See what is said under turpentine in a preceding chapter.—EDITOR.

theless, the mixture here indicated, will give a much more durable varnish than if no copal had been employed. The great division of this substance obtained by grinding, and by its mixture with other resins, favours the action of the spirit upon it; and the quantity dissolved is sufficient to give to this varnish a very remarkable degree of solidity, and which it would not have possessed in the same degree without copal.

If you are desirous to facilitate the solution of a greater quantity of copal, you may add to this formula 3-8ths of an ounce of camphor; but this quantity must not be exceeded.

Uses.

This varnish is designed for articles subject to friction, such as furniture, chairs, fan-sticks, mouldings, &c. and even metals, to which it may be applied with success. The sandarac gives it great durability.

First species of varnish of the same genus, intended for the same articles as No. II.

No. III.

Take of gum sandarac, 8 ounces.
Gum mastich, 2 ounces.
Clear turpentine, 4 ounces.
Pounded glass, 4 ounces.
Rectified spirit of wine, 32 ounces.

Remarks.

The formula for this varnish is from Watin. The proportion of the turpentine appears to be rather too

large; because it diffuses through the varnish a viscous matter, which renders it long in drying. Besides, it communicates to it a strong smell, which to many persons is exceedingly disagreeable. This formula authorizes an observation which may be applied to many other cases: when a substance, which by its nature and consistence is exceedingly soluble, is subjected to the action of spirit of wine, it precipitates in part the other dry substances which do not possess the same degree of solubility. A kind of resinous crystallization which covers the bottom of the vessel then takes place, if the mixture be left at rest. Hence it would be better to use only half of the turpentine directed above.

Notice.

It may be proper to state here, once for all, in order to avoid repetition, that *all gums or other hard bodies which can be pulverized, should be* invariably reduced to a state of gross powder before *being submitted to the action of any solvent.* If the *bodies be tough or very adhesive, such is sometimes gum elemi, they ought to be divided, by cutting, into small pieces, in order that the spirit or other menstruum may more* readily act upon them.

SECOND GENUS OF VARNISHES.

SPIRITUOUS VARNISHES LESS DRYING THAN THE FORMER, AND HAVING A WEAKER SMELL.

First species for cut-paper works, dressing-boxes, and other articles of the like kind, &c.

No. IV.

Take of gum sandarac, 6 ounces.
Gum elemi, 4 ounces.
Gum anima, 1 ounce.
Camphor, ½ ounce.
Pounded glass, 4 ounces.
Rectified spirit of wine, 32 ounces.

Make the varnish according to the method already directed. The soft resins may be pounded with the dry bodies. The camphor is to be added in pieces.

Remarks.

These varnishes of the second genus admit modifications in the nature of the substances which concur towards their formation. They are not so dry as those of the first genus. They give pliability, brilliancy, and solidity, to the compositions, without injuring their drying quality.

Second species of the same genus, designed for the same purposes.

No. V.

Take of frankincense, 6 ounces.
Gum anima } of each 2 ounces.
Gum elemi }

Pounded glass, 4 ounces.
Rectified spirit of wine, 32 ounces.

Make the varnish with the precautions directed for No. I.

Remarks.

Varnishes composed according to the last two formulæ, may be employed for the same purposes as those which form the first genus. They are much fitter, however, for ceilings and wainscoting, coloured or not coloured: they may even be employed as a covering to parts painted with strong water colours.

Third species of the same genus, for wainscoting, small articles of furniture, balustrades, and railing in the inside of a house.

No. VI.

Take of Gum sandarac, 6 ounces.
Shell lac, 2 ounces.
Yellow resin - -
White glass pounded } of each 4 ounces.
Clear turpentine, -
Rectified spirit of wine, 32 ounces.

Make the varnish according to the directions given for No. I *.

Remarks.

This varnish is sufficiently durable to be applied to articles designed for daily and continual use. Var-

* This varnish is very similar to that now known in this country under the name of FRENCH POLISH; see Chap. VI.—EDITOR.

nishes composed with copal ought, however, in these cases, to be preferred. There is another composition which, without forming part of the compound varnishes, is employed with success for giving a polish and lustre to furniture made of wood: wax forms the basis of it.

Many cabinet-makers are contented with *waxing* common furniture, such as tables, chests of drawers, &c. This covering, by means of repeated friction, soon acquires a polish and transparency which resemble those of varnish. Waxing seems to possess qualities peculiar to itself; but, like varnish, it is attended with its inconveniences as well as advantages.

Varnish supplies better the part of glazing; it gives a lustre to the wood which it covers, and heightens the colours of that intended, in particular, for delicate articles. These real and valuable advantages are counterbalanced by its want of consistence: it yields too easily to the shrinking or swelling of the wood, and rises in scales, or splits on being exposed to the slightest shock. These accidents can be repaired only by new coats of varnish, which render application to the varnisher necessary, and occasion trouble and expense.

Waxing resists percussion; but it does not possess, in the same degree as varnish, the property of giving lustre to the bodies on which it is applied, and of heightening their tints. The lustre it communicates is dull; but this inconvenience is compensated by the facility with which any accidents that may have altered its polish can be repaired by rubbing it with a piece of fine cork. There are some circumstances, therefore, under which the appli-

cation of wax ought to be preferred to that of varnish. This seems to be the case in particular with tables of walnut-tree wood in daily use, chairs, mouldings, and for all small articles subject to constant employment.

But as it is of importance to make the stratum of wax as thin as possible, in order that the veins of the wood may be more apparent, the following process will be very acceptable.

Melt, over a moderate fire, in a very clean vessel, two ounces of white or yellow wax; and, when liquefied, add four ounces of oil of turpentine. Stir the whole until it is entirely cool; the result will be a kind of pommade fit for waxing furniture, and which must be rubbed over it according to the usual method. The oil of turpentine is soon dissipated; but the wax, which by its mixture is reduced to a state of very great division, may be extended with more ease, and in a more uniform manner. The oil soon penetrates the pores of the wood, brings out the colour of it, causes the wax to adhere better, and the lustre which thence results is equal to that of varnish, without having any of its inconveniences.

Fourth species of the same genus. Varnish slightly coloured for violins and other stringed instruments, and even for furniture of plum-tree wood, mahogany, and rose-wood.

No. VII.

Take of gum sandarac, 4 ounces.
Seed lac, 2 ounces.

Gum mastich, } of each 1 ounce.
Gum Benjamin, }
Pounded glass, 4 ounces.
Venice turpentine, 2 ounces.
Rectified spirit of wine, 32 ounces.

The gum sandarac and lac render this varnish durable: it may be coloured with a little saffron or dragon's blood.

Fifth species of the same genus, which the turners of St. Claude employ for boxes made of box-wood, of the roots of trees, &c.

No. VIII.

Take of seed lac, 5 ounces.
Gum sandarac, 2 ounces.
Gum elemi, $1\frac{1}{2}$ ounce.
Venice turpentine, 2 ounces.
Pounded glass, 5 ounces.
Rectified spirit of wine, 24 ounces.

Remarks.

The artists of St. Claude do not all employ this formula, which required to be corrected on account of its too great dryness, which is here lessened by the turpentine and gum elemi. This composition prevents the cracking, which disfigures these boxes after they have been used for some months.

Other turners employ the gum lac united to a little elemi, and turpentine digested for some months in pure alcohol exposed to the sun. If this method be followed, it will be proper to substitute for the sandarac the same

quantity of gum lac reduced to powder, and not to add the turpentine to the spirit of wine, which ought to be exceedingly pure, till towards the end of the infusion.

Solar infusion requires care and attention. Vessels of a sufficient size to allow the spirituous vapours to circulate freely ought to be employed, because it is necessary that they should be closely stopped. Without this precaution some of the spirit would evaporate, and of course abandon the resin which it had dissolved. The perfect closing of the vessels will not admit of their being full.

In general, the varnishes applied to articles which may be put into the lathe, acquire a great deal of brilliancy by polishing. A piece of woollen cloth is sufficient for the operation. If turpentine predominate too much in these compositions the polish does not retain its lustre, because the heat of the hands is capable of softening the surface of the varnish, and in this state it readily tarnishes.

Sixth species of the same genus, for giving a gold tint to articles of brass.

No. IX.

Take of seed lac, 6 ounces.
Amber or copal ground fine, 2 ounces.
Dragon's blood, 40 grains.
Extract of red Saunder's wood obtained by water, 30 grains.
Hay saffron, 36 grains.
Pounded glass, 4 ounces.
Rectified spirit of wine, 40 ounces.

Remarks.

To apply this varnish to articles or ornaments of brass, expose them to a gentle heat, and dip them into the varnish. Two or three coatings may be applied in this manner if necessary. The varnish is durable, and has a beautiful colour. Articles varnished in this manner may be cleaned with water or a bit of dry rag.

Seventh species of the same genus. Changing varnish, or varnish designed to change or to modify the colour of those bodies to which it is applied.

No. X.

Take of gamboge, $\frac{3}{4}$ of an ounce.
Gum sandarac, } of each 2 ounces.
Gum elemi, }
Dragon's blood, 1 ounce.
Seed lac, 1 ounce.
Turmeric root, $\frac{3}{4}$ of an ounce.
Hay saffron, 12 grains.
Pounded glass, 3 ounces.
Rectified spirit of wine, 20 ounces.

Remarks.

A tincture of saffron and of the turmeric root must first be made by infusing them together in the spirit of wine for twenty-four hours, in a moderately warm place. The tincture must be strained through a piece of clean linen cloth, and the residuum ought to be strongly squeezed. This tincture is to be poured over the dragon's blood, the gum elemi, the seed lac, and the gamboge, all

pounded and mixed with the glass. The varnish is then to be made according to the directions already given.

It may be applied with great advantage to philosophical instruments: the use of it might be extended also to various cast or moulded articles with which furniture is ornamented.

If the dragon's blood impart too high a colour, the proportion may be lessened at pleasure, as well as that of the other colouring matters.

It is with a similar kind of varnish that the artists of Geneva give a golden orange colour to the small nails employed to ornament watch-cases; but they keep the process very secret. A beautiful bright colour might be easily communicated to this mixture; but they prefer the orange colour produced by certain compositions, the preparation of which has no relation to that of varnish, and which may be successfully imitated with saline mixtures, in which orpiment is a principal ingredient. The nails are heated before they are immersed in the varnish; and they are then spread out on sheets of dry paper *.

* *The two preceding formulæ for varnishes, as well as the next, are more properly designated in commerce* LACQUERS. It is obvious that these formulæ may be varied in many ways; the ingenuity of the artist will readily suggest them.—EDITOR.

Eighth species of the same genus. Changing varnish, which may be employed to give a gold colour to watch-cases, watch-keys, and other articles made of brass.

No. XI.

Take of Seed lac 6 ounces.

Amber, Gamboge, } of each 2 ounces.

Extract of red Saunder's wood in water 24 grains.

Dragon's blood 60 grains.

Hay saffron 36 grains.

Pounded glass 4 ounces.

Rectified spirit of wine 36 ounces.

Remarks.

Grind the amber, the seed lac, gamboge, and dragon's blood together: then mix them with the pounded glass, and add the spirit, after having previously formed with it an infusion of the saffron and of the extract of the Saunder's wood. The varnish must then be completed as before. The metal articles intended to be covered by this varnish are heated, and those which will admit of it are immersed in packets.

The tint of the varnish may be varied by modifying the proportions of the colouring substances.

The use of spirituous varnishes will long be preferred to that of the varnishes which form the third and fourth

genera; which, however, are far superior in all cases where it is necessary to add durability to the other qualities required.

The varnishes of these first two genera bear polishing as well as the hardest compositions which constitute the three other genera: but as they are more delicate, they require modifications in the operation. It is never begun with pumice stone.

Most of these varnishes are designed for covering preliminary preparations which have a certain degree of lustre. They consist of cement, coloured or not coloured, covered with landscapes and figures cut out in paper, which produce an effect under the transparent varnish: most of the dressing-boxes, and other small articles of the same kind, are covered with this particular composition, which, in general, consists of three or four coatings of Spanish white pounded in water, and mixed up with common glue. This first coating is smoothed with pumice stone, and then polished with a piece of new linen and water. The coating in this state is fit to receive the intended colour, after it has been ground with water and mixed with glue diluted with water. The cut figures with which it is to be embellished are then applied, and a coating of gum or isinglass is spread over them, to prevent the varnish from penetrating to the preparation, and from spoiling the figures. The operation is finished by applying three or four coatings of varnish, which, when dry, are polished with tripoli and water, by means of a piece of cloth. A lustre is then given to the surface with starch and a bit of doe skin, or very soft cloth.

THIRD GENUS OF VARNISHES.

The varnishes which compose the third genus are less exposed to the alterations to which those of the two preceding genera are sometimes subject. The nature of the solvent is here different: oil of turpentine is substituted in the place of spirit of wine. Almost all the resinous substances, and even the colouring substances, hitherto employed, are used in this third genus, and by their various mixtures with the oil, concur to accomplish the same views, and produce the same results.

It must not, however, be supposed, notwithstanding what has been here said, that the properties of spirit of wine, and those of oil of turpentine, are identical; they differ in many respects. Spirit becomes charged with some particular substances, which are insoluble in the oil: of this kind are certain colouring matters, such as indigo, turnsole, red Saunder's wood, saffron, &c. On these oil of turpentine produces no effect. In like manner, also, oil of turpentine, under certain circumstances, exerts all the energy of solution on copal, which resists spirit unless it be divided by a soluble body. At any rate, what it would dissolve without an intermediate substance would not be sufficient to constitute a varnish.

Varnishes made with oil are superior to those composed with spirit. The former unite pliableness and smoothness to brilliancy and durability: they yield better to the operation of polishing, and are less liable to crack than spirituous varnishes. All these qualities, which are well known, ought to induce artists to prefer

this genus in all cases where the preservation of the articles to which they are applied is an object of importance. This preference is necessary, in particular, for valuable paintings.

In spirituous varnishes the deposit of the resinous matter, divided and in a state of complete solution, is sooner formed, according as the season, or circumstances arising from an artificial temperature, accelerate the evaporation of the dividing fluid. The nature of this fluid is sufficiently known; and it gives no reason to suspect that any of its parts incorporate with the resinous moleculæ, the precipitation of which confirms the effect of a varnish: the alcohol then evaporates entirely.

The case is not the same with oil of turpentine, nor with other liquids which have all the characters of oils. They are not susceptible of entire evaporation. The less volatile oils are, the greater will be the solidity of the varnishes resulting from their mixture with resins, and *vice versa.*

Oil of turpentine, and oils of a greater density, which are still better, would alone form varnishes by repeated application. Spirit of wine in this case would disappear without leaving any trace.

The consistence which varnishes acquire from oil of turpentine is often increased by that arising from the particular nature of the matters which form part of the changing varnishes, and particularly of that of the varnishes distinguished by the name of *mordants.* In giving the formulæ for varnishes of this third kind, I

shall follow the order indicated by the degree of their tenacity, and of their resistance to desiccation.

First species of varnish for valuable paintings.

No. XII.

Take of Gum mastich, cleaned and washed, 12 ounces.
Pure turpentine, $1\frac{1}{2}$ ounce.
Camphor, $\frac{1}{2}$ ounce.
White glass pounded, 5 ounces.
Oil of turpentine, 36 ounces.

Make the varnish according to the method indicated for No. I. of the first genus. The camphor must be cut into pieces, and the turpentine added when the solution of the resin is completed. But if the varnish is to be applied to old paintings, or paintings which have been already varnished, the pure turpentine may be omitted, as this ingredient is here recommended only in cases of a first application to new paintings, and just freed from white of egg varnish.

Remarks.

The question proposed by able masters respecting the kind of varnish proper to be employed for paintings has never yet been determined. Every artist has his prejudices, strengthened by example or usage.

The varnish designed for this use ought to be colourless, if possible, that it may communicate no foreign tint to the tones of the painting; it ought to unite plia-

bility and smoothness to the most perfect transparency. It must not, however, have too much glazing, as the reflection of the light is injurious to the effect.

Spirit of wine renders varnishes too dry for paintings, as they split and crack. Varnishes composed with essential oils, which have too much body, give too great thickness to the coating, so that they cover or diminish the effect of the colours. But in choosing varnishes of this sort, one of the most requisite qualities is, that they should possess such a nature as not to resist the means employed, when it is necessary to substitute a new coating in the room of old varnish.

The following formula I have employed for thirty years; and the varnish resulting from it has been applied with success to paintings in the most valuable collections *.

Second species of varnish of the same genus, for grinding colours.

No. XIII.

Take of Fresh frankincense, 4 ounces.
Gum mastich, 2 ounces.
Venice turpentine, 6 ounces.
Pounded glass, 4 ounces.
Oil of turpentine, 32 ounces.

When the varnish is made with the precautions al-

* See *Observations on the Preservation and Repairing of Paintings*, in our *Painter's and Colourman's complete Guide*, p. 183.

ready indicated, add of prepared nut or linseed oil two ounces.

Remarks.

The matters ground with this varnish, which is nearly similar to that of Holland, dry more slowly; they are then mixed up with the following varnish, if it be for a common painting, or with particular varnishes designed for colours and for grounds. In treating of the different kinds of colours, I shall mention the species of varnish which ought to be employed in grinding them, and in mixing them up.

Watin substitutes in the room of the Dutch varnish, which is commonly employed for grinding colours, a composition which appears to me to be too much charged with ingredients. Oil of turpentine can scarcely dissolve the half of them. The rest forms a residuum which is mere loss *.

Third species of the same genus. Varnish proper to be employed in mixing up colours for grounds.

No. XIV.

Take of Frankincense, 12 ounces.
White glass pounded, 5 ounces.
Venice turpentine, 2 ounces.
Oil of turpentine, 32 ounces.

Make the varnish after the frankincense has been pounded with the glass.

* See his Art of making Varnish, edit. of 1772.

Remarks.

This varnish is, in fact, a mere turpentine varnish, and requires no glass to be employed in its preparation, although it is given above exactly as heretofore by M. Tingry. It is most conveniently made at once by melting, with the assistance of a moderate heat, in a suitable vessel, first the frankincense, adding to it, whilst hot, the Venice turpentine, and, lastly, the oil of turpentine; taking care that the whole mixture be made sufficiently hot to cause all the ingredients to be completely united; after which it should be strained, whilst hot, through a cloth or a hair sieve, when it may be set by for use.—EDITOR.

Some authors recommend mastich or sandarac in the room of frankincense; but the varnish is neither more beautiful nor more durable. When the colour is ground with the varnish No. XIII., and mixed up with the latter, which, if too thick, may be thinned with a little oil of turpentine, and which is applied immediately, and without any sizing, to boxes and other articles, the coatings acquire sufficient strength to resist the blows of a mallet. But if the varnish be applied to a sized colour, it must be covered with a varnish of the first or second genus.

Fourth species of the same genus. Changing varnish of a less drying quality than the species No. X., and applicable to metal.

No. XV.

Take of Seed lac, 4 ounces.

Sandarac or mastich, 4 ounces.

Dragon's blood, $\frac{1}{2}$ ounce.
Turmeric root, } of each 36 grains.
Gamboge, }
Pounded glass, 5 ounces.
Clear turpentine, 2 ounces.
Oil of turpentine, 32 ounces.

Make a tincture of the colouring substances; and then add the resinous bodies according to the prescription given for No. I.

Remarks.

Varnishes of this kind are called *changing*, because when applied to metals, such as copper, brass, or hammered tin, or to wooden boxes, and other furniture, they communicate to them a more agreeable colour. Besides, by their contact with the common metals they acquire a lustre which approaches that of the precious metals, and to which, in consequence of peculiar intrinsic qualities, or certain laws of convention, a much greater value is attached. It is by means of these changing varnishes that artists are able to communicate to thin leaves of silver and copper those shining colours observed on foils. This product of industry becomes a source of prosperity to the manufacturers of buttons and works formed with foil; and in the hands of the jeweller contributes with so much success to produce that reflection of the rays of light which doubles the lustre and sparkling quality of precious stones.

It is to varnish of this kind that we are indebted for the manufacture of gilt leather.

As the colours given by different colouring substances require tones suited to the objects for which they are designed, the artist has it in his power to vary them at pleasure. The addition of annatto to the mixture of dragon's blood, saffron, &c. or some changes in the doses of the more colouring bodies, will easily lead to the modifications desired to be made in the colours.

There is one very simple method by which artists may be enabled to obtain all the different tints they require. Infuse separately 4 ounces of gamboge in 32 ounces of oil of turpentine, and 4 ounces of dragon's blood and an ounce of annatto, also in separate portions of the oil. These infusions may be easily made in the sun. After fifteen days' exposure, pour a certain quantity of these liquors into a flask, and by varying the proportions you will obtain different shades of colour.

These infusions may be employed also for spirituous changing varnishes; but in this case the use of saffron, as well as that of red Saunders' wood, which does not succeed with oil of turpentine, will give the tone necessary for imitating with other tinctures the colour of gold. The fat golden varnish, already described, acquires its colour from a similar mixture of tinctures.

This genus of less drying varnishes admits also another species, which approach nearly to the nature of fat varnishes, and which are known under the name of *mordants.*

Fifth species of the same genus. Varnish distinguished by the name of mordant.

No. XVI.

Take of Gum mastich, 1 ounce.
Gum sandarac, 1 ounce.
Gamboge, $\frac{1}{2}$ ounce.
Turpentine, $\frac{1}{4}$ ounce.
Oil of turpentine, 6 ounces.

Remarks.

Some of the artists who make use of mordants, substitute for the turpentine an ounce of the oil of lavender, which renders this composition still less drying.

In general, the composition of mordants admits of modifications, according to the kind of work for which they are designed. The application of them, however, is confined chiefly to gold. When it is required to fill up a design with gold leaf, on any ground whatever, the composition which is to serve as the means of union between the metal and the ground, ought to be neither too thick nor too fluid; because both these circumstances are equally injurious to delicacy in the strokes: it will be requisite also that the composition should not dry till the artist has completed his design.

Besides, many artists never make use of prepared mordants. They substitute in their stead an extemporaneous mixture, which they alter at pleasure.

Some prepare their mordant with asphaltum and dry-

ing oil diluted with oil of turpentine. They employ it for gilding pale gold, or for bronzing.

Other artists imitate the Chinese, and mix with their mordants colour proper for assisting the tone which they are desirous of giving to the gold, such as yellow, red, &c.

Others employ merely the fat varnish of the fifth genus, No. XXI., to which they add a little red lead.

Others make use of thick glue, in which they dissolve a little honey. This is what they call *batture*. When they are desirous of heightening the colour of the gold, they employ this glue, to which the gold leaf adheres exceedingly well.

Every artist makes a mystery of his composition. I present mine because its qualities appear to me to be fit for every kind of application, and in particular for that to metals.

Expose boiled oil to a strong heat in a pan ; when a black smoke is disengaged from it, set it on fire, and extinguish it a few moments after by putting on the cover of the pan. Then pour the matter, still warm, into a heated bottle, and add to it a little oil of turpentine.

This mordant dries very speedily; it has body, and adheres to, and strongly retains, gold leaf when applied to wood, metals, and other substances.

These examples are sufficient to show the nature of the varnishes which compose the third genus. The following genus will make the reader acquainted with others which have still more solidity.

Under the head No. XXV. will be found another

mordant, still fatter, with which brown colours may be mixed.

FOURTH GENUS.

COPAL VARNISHES MADE WITH ETHER AND OIL OF TURPENTINE.

The dry nature of the resins which form the basis of the three preceding genera of varnishes, and their friability, announce that solidity is not one of their inherent qualities. The merit, indeed, of the most of these compositions seems to be confined to their drying quality and to their brilliancy. The two following genera will unite to these first characters consistence and solidity.

Copal, which serves as a basis to this fourth genus, seems to trace out an intermediate line between all the genera of varnish. The particular nature of this substance, which unites solidity to transparency, and the property it possesses of entering readily into solution, in a mean temperature, or a temperature approaching that of boiling water, are so many characters which supply varnish with all the qualities which are sought for in this kind of composition.

A process which furnishes the arts with a colourless varnish, possessed of a very drying quality; a sweet odour during the time of its evaporation, and in particular a great degree of solidity; a varnish which, when extended over metallic surfaces, forms a stratum of greater hardness than that found in the vitreous crust of enamel, since it opposes greater resistance to percus-

sion and to the friction of hard bodies, ought justly to be classed among those discoveries which are most interesting to certain useful arts. Two substances only concur towards its composition: copal and rectified ether.

This fourth genus of varnishes comprehends formulæ of many kinds, but they do not all possess the drying qualities in the same degree; hence they may be employed for different objects: the least drying will be proper for metallic articles, because their desiccation may be accelerated by means of a stove.

First species. Copal varnish with ether.

No. XVII.

Take of copal of an amber colour, $\frac{1}{2}$ ounce.
Sulphuric ether, 2 ounces.

Reduce the copal to very fine powder, and introduce it by small portions into the flask which contains the ether; close the flask with a glass or a cork stopper, and having shaken the mixture for half an hour, leave it at rest till the next morning. In shaking the flask, if the sides become covered with small undulations, and if the liquor be not exceedingly clear, the solution is incomplete. In this case add a little more ether, and leave the mixture at rest. The varnish is of a light lemon colour.

Remarks.

From accurate observation, it appears that the largest quantity of copal united to ether may be a fourth, and

the least a fifth. The use of copal varnish made with ether seems, by the expense attending it, to be confined to repairing those accidents which frequently happen to the enamel of toys, as it will supply the place of glass to the coloured varnishes employed for mending fractures, or to restoring the smooth surface of paintings which have been cracked and shattered.

The great volatility of ether, and in particular its high price, do not allow the application of this varnish to be recommended but for the purposes here indicated. It has been applied to wood with complete success, and the glazing it produced united lustre to solidity. In consequence of the too speedy evaporation of the liquid, it often boils under the brush. Its evaporation may be, however, retarded, by spreading over the wood a slight stratum of essential oil of rosemary, or lavender, or even of turpentine, which may be afterwards removed with a piece of linen rag: what remains will be sufficient to retard the evaporation of the ether.

Second species. Copal varnish with oil of turpentine.

No. XVIII.

Take of copal of an amber colour and in powder, 1½ ounce.
Oil of turpentine, 8 ounces.

Expose the oil to a water-bath, in a wide-mouthed matrass with a short neck: as soon as the water of the bath begins to boil, throw into the oil a large pinch of copal powder, and keep the matrass in a state of circular motion. When the powder is incorporated with the oil

add more of it: and continue in this manner till you observe that there is formed an insoluble deposit. Then take the matrass from the bath, and leave it at rest for some days. Draw off the clear varnish, and filter it through cotton.

Remarks.

At the moment when the first portion of the copal is thrown into the oil, if the powder precipitate itself in lumps, it is needless to proceed any further. This effect arises from two causes: either the oil does not possess the proper degree of concentration, or it has not been sufficiently deprived of water. Exposure to the sun, employing the same matrass, to which a cork stopper ought to be added, will give it the qualities requisite for the solution of the copal. This effect will be seen by the disappearance of the portion of copal already put into it.

To obtain this varnish colourless, it may be proper to rectify the oil of the shops, and to give it the necessary density by exposure to the sun in bottles closed with cork stoppers, leaving an interval of some inches between the stopper and the surface of the liquid. A few months are thus sufficient to communicate to it the required qualities.

This solution of copal in oil of turpentine is an exceedingly durable and brilliant varnish. It resists percussion much better than the enamel of toys, which often becomes scratched and whitened by friction; it is susceptible also of a fine polish. It is applied with the

greatest success to philosophical instruments, and the paintings with which vessels and other utensils of metal are decorated.

Third species. Copal varnish, made with oil of turpentine, by means of an intermediate substance.

No. XIX.

Take of copal in powder, 1 ounce.
Essential oil of lavender, 2 ounces.
Oil of turpentine, 6 ounces.

Put the essential oil of lavender into a matrass of a proper size, placed on a sand-heat, made hot by an Argand's lamp, or over a moderate coal-fire. Add to the oil while very warm, and at several times, the copal powder, and stir the mixture with a stick of white wood rounded at the end. When the copal has entirely disappeared, add at three different times the oil of turpentine almost in a state of ebullition, and keep continually stirring the mixture. When the solution is completed, the result will be a varnish of a gold colour, exceedingly durable and brilliant, but less drying than the preceding.

Remarks.

This method may have some advantage over the preceding, in case oil of a proper specific quality, and such as I have recommended, can be procured.

Oil of turpentine is capable, in this particular case, of dissolving copal, and so also is spirit of wine. This may be easily proved by a very simple experiment.

Put essential oil of lavender into a table spoon, and heat it. When it is almost in a state of ebullition add a pinch of copal in powder. Facilitate the mixture by stirring it; and when the copal is dissolved, add a fresh portion till the oil can dissolve no more. Pour the solution into a phial containing boiling spirit of wine, and stir the mixture, keeping it always at the same degree of temperature. The spirit of wine will soon unite with both these substances.

If you are desirous of completing the experiment without changing the vessel; that is to say, if you employ a metallic vessel capable of containing the spirit added to the oily solution of copal, a part only of the boiling spirit must be poured in, stirring the mixture with the stick. The copal, which forms itself into a ball, soon dissolves in the vehicle. This circumstance allows the remainder of the alcohol to be added, without any precipitation.

It may be readily perceived that this varnish belongs to the second genus, which comprehends the less drying spirit varnishes. I introduce it here, merely to serve as a new proof of the existence of processes capable of effecting a complete solution of copal in the different liquids commonly employed in the composition of varnishes. If larger quantities were employed in this process, the varnish-alembic, which I shall describe in the following chapter, would be exceedingly proper.

Fourth species. Copal varnish by an intermediate substance, according to a method given in the Journal de Physique.

No. XX.

Take of copal, 4 ounces.
Clear turpentine, 1 ounce.

Put the copal, coarsely pulverized, into a varnish pot, and give it the form of a pyramid, which must be covered with turpentine. Shut the vessel closely, and, placing it over a gentle fire, increase the heat gradually, that it may not attack the copal. As soon as the matter is well liquefied, pour it upon a plate of copper, and when it has resumed its consistence reduce it to powder.

Put half an ounce of this powder into a matrass with four ounces of the essence * of turpentine, and stir the mixture till the solid matter is entirely dissolved.

Remarks.

This varnish is coloured, and has no advantage over that of No. XVIII. The turpentine, which by the action of the heat has undergone a commencement of decomposition, even before the copal has entered into a state of liquefaction, contributes greatly to give it this colour. In this respect it is even inferior to No. XIX.

* What M. Tingry meant by *essence* of turpentine is, we presume, a rectified oil of turpentine. Oil of turpentine is in this country to be obtained so pure and colourless as not generally to require a second distillation. It might sometimes be mixed with fat oils, when, of course, it must be unfit for many of the purposes of the varnish-maker, particularly when employed in *spirit* varnish.—EDITOR.

Fifth species. Copal varnish by the medium of camphor and essential oil of lavender, designed for articles which require durability, pliability, and transparency; such as the varnished wire gauze used in ships instead of glass.

No. XXI.

Take of pulverized copal, 2 ounces.
Essential oil of lavender, 6 ounces.
Camphor, $\frac{1}{8}$ of an ounce.
Oil of turpentine a sufficient quantity, according to the consistence required to be given to the varnish.

Put into a phial of thin glass, or into a small matrass, the essential oil of lavender and the camphor; and bring the oil and the camphor to a slight state of ebullition. Then add the copal powder in small portions, which must be renewed as they dissolve in the liquid. Favour the solution by continually stirring it with a stick of white wood; and when the copal is incorporated with the oil, add the oil of turpentine boiling; but care must be taken to pour in at first only a small portion.

An inverse method might be followed, by pouring the essential oil camphorated and boiling on the copal, liquefied separately in the matrass; but this method requires more practice. Besides, it would give a darker colour to the varnish.

This varnish is but little coloured; and by rest it acquires a transparency which, united to the solidity

possessed by almost every kind of copal varnish, renders it fit to be applied with great success in many cases, and particularly in the ingenious invention of substituting varnished metallic gauze in the room of Muscovy talc, a kind of mica in large laminæ, used for the cabin windows of ships, as presenting more resistance to the concussion of the air during the firing of the guns. Varnished metallic gauze of this kind is manufactured, I believe, at Rouen, or in the neighbourhood.

All these attempts, the principal object of which was to find the means of making copal unite with any liquid, without having recourse to such a high temperature, that might in some degree decompose it, seem to point out the boundaries of the art, without destroying the hope of obtaining complete success. The pliability and tenacity of this singular substance, when subjected to a series of processes, give reason to believe that it may rival that which constitutes the Chinese varnish, provided the solution of it can be rendered easy, and secure from those alterations which take place during the common operation. It does not appear that the different intermediate substances hitherto employed have been attended with complete success, or at least such success as supersedes the necessity of further researches.

Before I proceed to a simpler method, I must here offer some observations and experiments in regard to the influence of intermediate substances, and particularly that of camphor, or the solution of copal in alcohol.

Camphor, which I have employed for thirty years, as

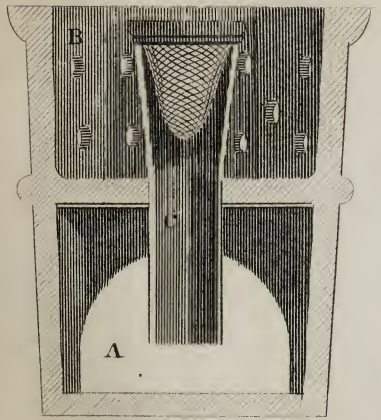

Fig. 1.

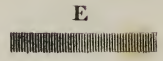

Fig. 2.

Fig. 3.

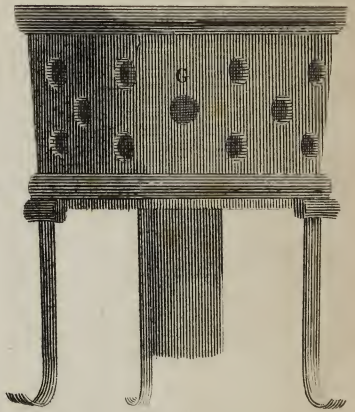

Fig. 4.

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a medium to facilitate the solution of resin in the composition of varnish destined for valuable paintings *, might be applied in my process in doses of from 24 to 30 grains for every ounce of the oil of lavender. It has indeed the singular property of altering the consistence of the driest resins, and of rendering them soft. In this union, which appears to be intimate, the camphor itself loses the character which distinguishes it from an essential oil, that is to say, dryness. Apothecaries have every day an opportunity of verifying this fact, when they prescribe a mixture of camphor in plasters, the base of which is resinous. It softens them to such a degree, that it is impossible to preserve the consistence of plaster, if the quantity be carried beyond 30 or 40 grains for each ounce of resin.

Description of a furnace designed for the liquefaction of copal and amber.

This furnace, a section of which is represented fig. 1. plate I. may be entirely constructed of burnt clay, three large apertures being made in the lower chamber, A, which supplies the place of an ash-hole in the common furnaces. The upper part of these apertures is arched; and the pillars or solid parts between them should be as narrow as possible, in order to enable the artist with facility to extract the liquefied matter, and even to mix it with the drying oil, if this kind of varnish be required.

* See No. XII.

The upper part, B, or fire-place of the furnace, is separated from the lower part, A, by a bottom or plate, which answers the same purpose as a grate in common furnaces. This plate has in the middle a circular aperture, the diameter of which corresponds to that of the tube, C, which it is designed to receive, and which extends a considerable way below it. This plate may either form one piece with the furnace, or may be moveable. In the latter case it is supported by three projections, or by a circular ledge which projects inwards. In my furnace this partition is composed of an iron plate covered with a coating of potters' clay an inch in thickness. This precaution is indispensably necessary to prevent the heat from penetrating to the lower division, A.

The sides of the fire-place, B, are pierced with holes an inch in diameter, and distant from each other about three inches. These apertures admit air sufficient to maintain the heat at the degree proper for this kind of operation. The following are the proportions of the three parts of this furnace, which served me for my experiments, and in which I liquefied six ounces of copal in the space of ten minutes, without altering its colour.

	Inches.
Total height of the furnace	17½
Height of the lower chamber, A, including the bottom, which was an inch in thickness	11
Height of the upper chamber, B, or of the fire-place	5½

	Inches.
Diameter, taken at the upper interior edge of the fire-place, B.	$9\frac{1}{2}$
Diameter of the same, taken at the bottom or partition	7

This part decreases in diameter $2\frac{1}{2}$ inches, tapering towards the lower part of the furnace, A.

The tube, C, is conical at the upper extremity, and cylindrical towards the bottom; it is $9\frac{1}{2}$ inches in length, $4\frac{1}{2}$ in diameter at the top, and $2\frac{1}{2}$ towards the middle. Both ends of it are open.

The tube, C, is placed in the aperture formed in the middle of the partition, in such a manner as to rise three or four inches into the fire-place. The place where it joins to the partition is luted with clay, to prevent the ashes or small coal from falling down.

When this arrangement is made, the net, D, (see fig. 2.) made of brass wire worked very open, is placed in the tube. It has the shape of a funnel, the upper edge of which is made fast to a ring of wire of the same diameter as the upper part of the tube, C. The decrease in the diameter of the tube, C, conduces to the stability of this net, and the conical form of the latter prevents it from coming into contact with the lateral parts of the tube, which is a matter of great importance to preserve the copal from too great alteration by the heat.

The copal is placed on this metallic filter in pieces not larger than a small nut, and the whole is closed up with the iron plate or cover, E, an inch in thickness,

taking care to lute the joining with clay, to prevent all communication with the exterior air.

A shallow dish or capsule, F, filled with water, (fig. 3.) is placed under the bottom of the tube, C, in such a manner that the tube is immersed in the water two or three lines.

The fire-place, B, being filled with burning coals so as to rise above the iron cover of the tube, the first action of the heat on the copal is discovered by a kind of crackling, the consequence of its dilation, which makes it split into small pieces; soon after which it melts. A small iron pallet-knife, terminating in an elbow, is introduced under the tube, and moved in such a manner as to cause the liquefied part of the copal to fall down into the water, and to bring it under the solid form towards the edge of the capsule. When the operation is finished, the copal is spread out on dry linen cloths, or on unsized paper, and then dried by a gentle heat.

While the melted copal is falling down, a very small portion of oil separates, which remains fluid after the operation. It floats on the water as well as the copal, and gives to the latter a greasy appearance. But when the tube is of sufficient length there will be no necessity for immersing the end of it in the water, or even for receiving the matter in the water; but, in this case, a kind of smoke will escape, which may be offensive to the artist. The essential point is to regulate the fire in such a manner as not to alter the colour of the copal. If a very thick smoke issues through the lower aperture of the

tube when red hot, and when the drops which fall into the water rise into bladders and burst, there is reason to conclude that the fire is too violent.

I have succeeded in composing varnish with fat oil, in the same operation, by substituting drying oil in a state of ebullition for the water, and keeping it in that state by means of a mass of very hot iron, which served it as a supporter. The mixture of the liquefied matter is facilitated by means of a spatula, with a knee at the extremity; and the boiling oil of turpentine is afterwards added. The inconvenience of placing a volatile and highly inflammable oil under the apparatus may be readily conceived.

I shall always insist more on the separate liquefaction of copal, than on the possibility of completing the mixture of it with a drying oil, to form a varnish of the fifth genus. This new mean enables the artist to compose a very durable and nearly colourless varnish, superior to copal varnish composed with drying oil, as the composition of the latter requires processes which alter the essential qualities of the substances that form the basis of it.

For operations on a larger scale the dimensions of the furnace may be changed; but in this case it will be proper to put the fire-place, properly so called, on a kind of iron tripod, as represented at G, fig. 4, in order that the workman may be more at his ease. There is, however, great advantage in employing not more than six ounces of copal in one operation.

The advantages of this new method will be perceived

when a trial has been made of the varnish composed with oil of turpentine and copal melted by it. Copal, thus prepared, has properties different from, and more extensive than, those communicated to it by the common method; and it has not that dark brown colour which it acquires by too high a temperature, and too long exposure to heat. In a word, it is impossible to prepare fat copal varnish, possessing little colour, except by making use of oil very little coloured, such as that of poppy prepared in leaden vessels, according to Watin's method.

In like manner also this copal, simply modified, may increase the solidity of spirituous varnish in a more direct manner than when it is employed without any preliminary preparation. A second liquefaction would perhaps give it the property of being soluble in spirit in greater quantity; but there would be reason to apprehend that the alteration in its principles, carried too far, would give it no superiority over those resins which are most soluble in that liquid.

Sixth species. Copal varnish with oil of turpentine, without any intermediate substance.

No. XXII.

Take of Copal liquefied, according to my method, 3 ounces.
Oil of turpentine, 20 ounces.

Place the matrass containing the oil in a water bath, and when the water is warm add the pulverized

copal in small quantities. Keep stirring the mixture, and add no more copal till the former be incorporated with the oil. If the oil take up three ounces of it, add a little more; but stop when the liquid becomes cloudy; then leave the varnish at the rest. If it be too thick, dilute it with a little warm oil, after having heated it in the balneum mariæ. When cold, filter it through cotton.

This varnish has a good consistence, and is as free from colour as the best spirituous varnish. When extended in one stratum over smooth wood, which has undergone no preparation, it forms a very brilliant glazing, which, in the course of two days in summer, acquires all the solidity that may be required.

The same oil employed with copal of two fusions, that is to say, copal liquefied a second time, takes up a third more than in the former case. But it produces very little effect on copal not prepared.

The facility which attends the preparation of this varnish by the new method here indicated, will admit of its being applied to all coloured grounds which require solidity, pure whites alone excepted. Painted boxes, therefore, and all small articles, coloured or not coloured, where it is required to make the veins appear in all the richness of their tones, call for the application of this varnish, which produces the most beautiful effect, and which is more durable than turpentine varnishes composed with other resinous substances.

FIFTH GENUS.

FAT VARNISHES.

The varnishes of this genus are the most durable, but they are the slowest in drying. They are designed for objects exposed to friction, or to percussion; and are particularly employed for the decoration of carriages. They are applied to wood, to iron, to brass, and to copper; they are used also for waiters, Argand's lamps, tea-pots, and other utensils of the same kind.

The matters which enter into the composition of these varnishes are copal, amber, caoutchouc, essential oils, prepared linseed oil, nut, and poppy oil, &c.

Copal melts more readily than amber. It is more susceptible of decomposition; and the varnish resulting from the mixture of it with any oil is not so dark as that obtained from a mixture of amber with the same oil. If copal were mixed with amber in the same operation, it would in a great measure be destroyed before the latter was in a state of liquefaction.

Though the proportions indicated in the different formulæ for this fifth genus of varnishes have been proved, the last portions of the copal, and particularly of the amber, must not be melted if the varnish be required as little coloured as possible. The portions of the amber which have escaped liquefaction may be easily separated by a sieve, or by deposition. Copal presents less resistance, and, when employed in small fragments, is soon liquefied. In other respects, the method indicated at the end of the description of the furnace is re-

commended, because the matter, when once liquefied, escapes from the burning atmosphere, the continued influence of which would have a prejudicial effect on the nature of the substance, and consequently diminish the solidity of the varnish.

First species. Extracted from Watin's work.

No. XXIII.

Take of Picked copal, 16 ounces.
Prepared linseed oil, or oil of poppies, 8 ounces.
Oil of turpentine, 16 ounces.

Liquefy the copal in a matrass over a common fire, and then add the linseed oil, or oil of poppies, previously made very hot*: when these matters are incorporated, take the matrass from the fire, stir the matter till the heat has in part subsided, and then add the oil of turpentine previously made warm. Strain the whole, while still hot, through a piece of linen, and put the varnish into a wide-mouthed bottle. By keeping it improves and becomes clearer.

In general there is much advantage in not employing too violent a heat. The varnish by these means succeeds better, and acquires less colour. If it afterwards becomes too thick, add a little warm oil of turpentine, that the mixture may take place more speedily. It was

* In the last edition of this work, the direction here was "in a state of ebullition;" but the heat required *to boil* oil is not here necessary.

in this manner that the celebrated Martin composed his beautiful white fat varnishes.

Second species of the same genus, employed in the manufactories of Geneva for watch-cases, in imitation of tortoise-shell.

No. XXIV.

Take of copal of an amber colour, 6 ounces.
Venice turpentine, $1\frac{1}{2}$ ounce.
Prepared linseed oil, 24 ounces.
Oil of turpentine, 6 ounces.

It is customary to place the Venice turpentine over the copal, reduced to small fragments, in the bottom of an earthen or metal vessel, or in a matrass exposed to such a heat as to liquefy the copal: but it is more advantageous to liquefy the latter alone, to add the linseed oil previously made very hot, then the Venice turpentine liquefied, and, in the last place, the oil of turpentine. If the varnish be too thick, some oil of turpentine may be added.

The proportion of oil, in this case, appears too great: eighteen ounces would be sufficient. This varnish is durable and transparent; but it dries with difficulty; in general a stove is employed to hasten it: it is susceptible of a fine polish.—*See the last paragraph under* No. XXIII.

Third species. Amber Varnish.

No. XXV.

Take of amber, coarsely pounded, 16 ounces.
Venice turpentine, or gum lac, 2 ounces.

Prepared linseed oil, 10 ounces.
Oil of turpentine, 15 or 16 ounces.

The circumstances of the process are the same as those prescribed for the preparation of the copal varnish, No. XXI.

Remarks.

This varnish was formerly much used; but it has given place, in part, to that of copal, which is preferred on account of its being less coloured. Watin introduces more oil of turpentine and less linseed oil: experience and long practice are the only authority on which the present formula is recommended.

Copal varnish without mixture is of an amber colour and very transparent. When mixed with amber the varnish is of a very dark brown colour.

Setting out from this fact, the mixture of turpentine is more proper with linseed oil than with amber; and the oil ought to be very hot when poured on the melted amber. But this precaution is still not sufficient, if it be required, as ought to be the case, that the three substances in contact should unite in a speedy and intimate manner. If the whole quantity of oil added to the turpentine were poured in at one time, a portion of the amber would be precipitated; it ought to be effected at several times, taking care to facilitate the contact by stirring the mixture with an iron rod. It will also be proper to bring the mixed matter to a state of considerable heat before it is taken from the fire. Of course the more heat is employed the more coloured will the varnish become.

Some artists do not wait till the whole of the amber is in a complete state of liquefaction before they add the oil: they are satisfied with liquefying a part; and they then separate the fragments of the amber which have not been melted. By this method the varnish is less coloured; but it requires more amber or copal than is prescribed in this formula.

Sometimes the operation is stopped by the fear of not finding vessels capable of standing the whole of it. A cast-iron pot will obviate this inconvenience, and ought to be preferred to vessels of earthenware, which either crack or split. When porous they are soon penetrated by the varnish: besides, they can be employed only once; the second varnish made in them would acquire too dark a colour. A cast-iron pot has this advantage also over pottery, that it can be cleaned, while warm, to remove the portions of the old varnish, which would be coloured by the fire employed for a new composition.

Before I proceed to the composition of the other varnishes which belong to this last genus, it may be of use to take a view of the processes I have followed in treating copal in a manner entirely new, and to apply them to amber. On comparing the results exhibited by these two singular substances, when employed in varnish, it will be seen that the one which, when it appears under its natural characters, seems to have a superiority over the other, resigns it to the other when it has been brought to the necessary degree of liquefaction, before it is mixed with oils in the process of making varnish. What is then considered as an essential quality in amber

becomes prejudicial to it when applied to the composition of varnish; because the great heat required for its liquefaction alters its principles much more than is the case in the liquefaction of copal, which requires less heat, and of course more readily melts. The following experiment will give some weight to this assertion.

Preparation of amber according to the melting process already described for Copal.

Five ounces of amber, of a very dark orange colour, but transparent, and in pieces of the size of a small nut *, treated in the melting furnace, required a half more time than copal before it exhibited the first indications of liquefaction, the fire in both cases being subjected to the same regulation. A great deal of pretty thick oil, and which always retained that consistence, was disengaged. It envelopes in such a manner the parts which acquire solidity by cooling, that it is difficult to separate it by immersion in tepid water, and by means of blotting paper. However, by exposing the amber to the air for some days it becomes so solid that the laminæ it forms may be broken between the fingers. In this state these laminæ have the transparency and colour of the hyacinth. The amber is obtained under this form, when care is taken to bring it to the edge of the vessel, filled with water, into which it flows, by

* The amber to be liquefied must not be employed in pieces too large, or in coarse powder, because it soon forms a mass, and does not run so freely. It is indeed very slow, and furnishes more fluid oil than in the present case: the varnishes also are more coloured.

means of a hook, or pallet-knife bent at the extremity. This matter, which is pretty dry in appearance, when pounded in a mortar forms itself into a small mass, which readily crumbles to pieces. It is indebted for this flexible quality only to a portion of the free oil, which covers the surface of it under the form of a varnish. When this consistence is compared with that assumed by copal under similar circumstances, one may readily be convinced that the latter, the consistence of which is drier and even pulverulent, is preferable to amber for the preparation of varnish. Nevertheless as it is still possible that some artists may prefer an amber varnish the following formula may be followed to obtain it.

Amber varnish with oil of turpentine.

Take of Amber, liquefied according to the preceding process, and separated from the oily portions which alter its consistence, 6 or 7 ounces.
Common oil of turpentine 24 ounces.

Reduce the amber to powder, and if the operation of pounding forms it into a paste, break it with your fingers; then mix it with the oil, and treat the whole in a balneum mariæ. It will speedily dissolve, and the oil will take up at least a fourth part of its weight of the prepared amber.

This varnish is more coloured than that made with copal and turpentine: but it readily clarifies, even without filtering it through cotton.

When one coating of it is applied to white smooth

wood, but without any preparation, it forms a very pure and very durable glazing, which speedily dries, but more slowly than copal varnish.

As copal and amber must be liquefied before they are mixed with drying oils, it may be advantageous to follow the melting process under such circumstances as may seem to favour the preference given to drying oils over oil of turpentine. The following formula was attended with complete success.

Fourth Species. Fat amber or copal varnish.

No. XXVI.

Take of Amber or copal of one fusion 4 ounces.

Oil of turpentine
Drying linseed oil } of each 10 ounces.

Put the whole into a pretty large matrass, and expose it to the heat of a balneum mariæ, or move it over the surface of an uncovered chafing dish, but without flame, and at the distance from it of two or three inches. When the solution is completed, add still a little copal or amber to saturate the liquid; then pour the whole on a filter prepared with cotton, and leave it to clarify by rest. If the varnish is too thick, add a little warm oil of turpentine, to prevent the separation of any of the amber.

This varnish is coloured, but far less so than those composed by the usual method. When spread over white wood, without any preparation, it forms a solid glazing, and communicates a slight tint to the wood.

If you are desirous of charging this varnish with more copal or prepared amber, the liquid must be composed of two parts of oil of turpentine and one of fat oil *.

Thewhole of the processes here given, and which may be applied to the composition of varnishes of the fourth and fifth genera, leave no doubt in regard to the course which will be followed by artists who know how to make use of the advantages which they offer, and to compare them with each other. I am persuaded that they will give a decided preference to turpentine varnishes treated according to my method; and that, in future, they will confine fat varnishes to common objects, if they are still retained, notwithstanding the defects with which it is well known they are attended. I shall conclude this chapter with an account of three compositions which may be esteemed by some artists: but I must recommend the use of amber, prepared according to the method which I have already described.

* Amber prepared according to the preceding method is dissolved by spirit of wine, to which it communicates a lemon colour. What distinguishes it from copal is, that it retains its pulverulent form in the heat used for fusion in a balneum mariæ. The tincture resulting from this mixture is attended with no greater advantage to varnishes than those extracted from copal.

Ether exercises on it a more striking action; it readily attacks and dissolves it. The varnish it produces is coloured. When deposited on wood dipped in oil, and afterwards well rubbed with a view to render the dissipation of the ether slower, it left a solid coating of varnish with a beautiful gold tint: when spread over wood not immersed in oil, it left a coating which resembled pale gold.

Fifth species of the same genus. Fat varnish of a gold colour.

No. XXVII.

Take of amber prepared according to my method, 8 ounces.
Gum lac 2 ounces.
Drying linseed oil 8 ounces.
Oil of turpentine 16 ounces.

Dissolve separately the gum lac; and then add the amber, prepared and pulverized, with the linseed oil and essence very warm. When the whole has lost a part of its heat, mix in relative proportions tinctures of anatto, of turmeric root, gamboge, and dragon's blood, as mentioned page 68. This varnish, when applied to white metals, gives them a gold colour.

Sixth species of the same genus. Fat varnish, which may serve as a mordant to gold, and at the same time to dark colours *.

No. XXVIII.

Take of boiled linseed oil 16 ounces.
Venice turpentine 8 ounces.
Naples yellow 5 ounces.

* The varnish No. XVI. of the third genus, that is to say, with oil of turpentine, is also a mordant.

Heat the oil with the turpentine, and mix the Naples yellow pulverized.

Remarks.

Naples yellow is chiefly an oxide of lead. It is substituted here for resins, on account of its drying quality, and in particular of its colour, which resembles that of gold. Great use is made of this varnish in applying gold leaf.

The yellow, however, may be omitted when this species of varnish is to be applied to solid and coloured coverings. In this case an ounce of litharge to each pound of composition may be substituted in its stead, without this mixture doing any injury to the colour which is to constitute the ground.

There is still another species of varnish, which, like the above, might form a part of those of the third genus, if the matter which serves as the basis of it did not require a drying oil to be employed: it is that of caoutchouc.

Seventh species of the same Genus. Caoutchouc Varnish.

No. XXIX.

Take of Caoutchouc or Indian rubber
Boiled linseed oil - - - -
Oil of turpentine - - -
} of each 16 ounces.

Cut the caoutchouc into thin slips, and put them into a matrass placed in a very hot sand bath. When the

matter is liquefied, add the linseed oil in a state of ebullition *, and then the oil of turpentine warm. When the varnish has lost a great part of its heat, strain it through a piece of linen, and preserve it in a wide-mouthed bottle. This varnish dries very slowly; a fault which is owing to the peculiar nature of the caoutchouc.

Remarks.

The solution of this singular substance is not confined to essential or fat oils. Macquer applied ether to it with success †; but the processes he indicates do not always answer, and cannot form a part of those which we are desirous to place within the reach of the public in general.

In repeating these experiments, I found that the union of caoutchouc and ether did not take place till the volume of that fluid was reduced one half by the effect of evaporation. It appears therefore that ether exercises a better action on this substance according as it has less tenacity, and as it approaches more to the oily nature. In consequence of this principle, the best rectified ether refuses to form any kind of union with caoutchouc. This, perhaps, is the chemical reason proper to be adduced, in order to account for the difference between the experiments of Macquer and those of Berniard ‡.

* See what is said in page 99, relative to the ebullition of oil.

† See Mémoires de l'Academie des Sciences, 1768.

‡ See the article *Caoutchouc*, and also the next chapter.

CHAPTER V.

General observations and precepts respecting the preparation of varnish on a large scale. Description of an alembic with a balneum mariæ, the use of which prevents all those accidents that frequently accompany the making of varnish.

ALTHOUGH, as will be seen in other parts of this work, the pure *gums*, *isinglass*, the *white of eggs*, and a few other substances, and *water*, may sometimes become ingredients in varnish, yet it is to the resinous and gum-resinous substances to which we are indebted for our best varnish. Again, although many liquids are occasionally used as vehicles for varnish, the chief are, nevertheless, *spirit of wine*, the *essential oils*, extracted by distillation from vegetables, and the *fixed or fat oils*.

Transparency, limpidity and lustre, are the essential qualities of most varnishes. There are others, however, nearly as important, such as those of drying speedily, and giving solidity to the resinous stratum which serves as a glazing to the bodies which they cover. A composition of this kind ought at the same time to be colourless, in order that it may not weaken or disfigure the tints of the colours which it covers and which it

ought, on the contrary, to bring out in their full brightness, by preserving them from the influence of the air and of moisture.

The choice, therefore, is very much limited; and it might still be confined within narrower bounds, without doing much injury to the art. Gum sandarac, employed formerly by the Arabs for this purpose, was the only matter which seemed likely to answer the proposed end. It is easily prepared, and possesses lustre; but it is attended with the disadvantage of a little dryness, which however may be corrected. Turpentine, and all the modifications of it by the effect of evaporation; mastich, which has more solidity than sandarac; gum anima, and gum elemi, gum lac, and copal, compose nearly the catalogue of the matters which are employed for the composition of drying varnishes, or those made with spirit of wine. The extreme dryness of some of them is corrected by uniting them with others which are less dry, and which still retain a portion of essential oil, such as gum elemi, gum anima, camphor, and turpentine. The same effect is produced also by substituting instead of spirit of wine a less dry fluid, such as oil of turpentine.

Experience has set bounds to the number of the liquids proper for serving as vehicles in the composition of varnish. The nature of spirit of wine was suited to light, drying, and colourless compositions, when artists were desirous to correct the strong odour which accompanies most varnishes.

In examining the essential oils, artists must have first

distinguished those which on account of their lightness seemed to exhibit intermediate qualities between spirit of wine and oils of the greatest consistence: hence the use of oil of turpentine, and oil of lavender.

Oil of turpentine gives to varnish more body than spirit of wine: it might indeed be substituted in all cases for it, if the strong odour it emits were not, to some persons, a cause for rejecting it. For varnishes, however, designed to be applied to ceilings, wainscoting, and furniture, it is far superior; because it renders them equally brilliant, and gives them more durability. During the summer, in particular, this odour is soon destroyed; and if the artist takes care to employ a spirit varnish for the last coat, there will be no odour at all.

The use of essential oil of lavender is more applicable to delicate oil painting than to the art of the varnisher. Though naturally drier, next to oil of turpentine, than other essential oils, it is still too fat and unctuous for varnishes. It may, however, be introduced in small quantities in the composition of varnishes made with spirit of wine and oil of turpentine, when it is necessary to lessen their drying quality, or when metallic colours are used in the state of pure oxides.

The other essential oils known in commerce are either too dear, or too fat, or too much coloured, to form part of the liquors for the solution of resins.

The number of the fat or fixed oils useful to the art is as much limited as that of the essential or volatile oils. Oil of white poppy seed, nut oil, and linseed oil, are the only ones found by experience to be fit for the compo-

sition of fat varnishes, when they have undergone preliminary preparations which deprive them of their unctuous quality, and render them drying. Olive oil being without much colour would answer the purpose of the artist better than nut oil or linseed oil, which are always coloured, if it did not possess an unctuous matter, which can be removed only by destroying a part of the oil itself. The case is the same with oil of turnips and oil of hemp seed: and the processes to which the seeds of the beech tree are subjected before the oil is expressed from them, give it a red colour, which renders it unfit for varnish.

To judge, then, from the results alone, varnishes, such as they are exhibited by our five genera, are nothing but solutions of pure resins, or resinous gums, in an appropriate spirituous or oily liquid. Acid liquors, therefore, and alkaline liquors, though the latter have the property of combining with oils and with resins, and of reducing them to the saponaceous state, are in no case endowed with the essential qualities requisite for the composition of varnishes.

If saline, acid, and alkaline liquors, considered as solvents, are incapable of answering the views of the varnisher; water, a simple substance, without odour and almost without savour, is no less contrary to them. It is the nature of resins to resist its action. Water also has the property of uniting with the spirit of wine, which holds a resin in solution, and of precipitating the latter under the form of a white powder. *These effects require the most scrupulous attention on the part of the artist,*

in regard to the choice of the spirit he intends to employ in his compositions. The best brandy, and even spirit superior to brandy, if of greater specific gravity than 0.835, are unfit for making varnish. The water which such liquors contain is an obstacle to the solution of resins; and it precipitates the resinous portion which the spirituous part has been able to dissolve by the aid of heat. The solution is at any rate turbid, and very difficult of clarification. Some resins should be washed before they are employed in the composition of varnish. Mastich, sandarac, and even copal itself, which is divided into small portions, &c. require previous washing, which is attended with no kind of inconvenience. The case would be the same with amber, were not this precaution rendered useless by the process to which it is subjected.

These resins are immersed in water after the fine powder has been separated from them by a hair sieve. The fragments and resinous tears are then rubbed between the hands to detach the dust, the lighter parts, and the fragments of bark. These separated parts float on the surface; and, in consequence of their lightness, afford the means of removing them with facility. The washed resin is then spread out on a piece of dry linen cloth, or a hair sieve, which is covered with a sheet of paper; and the whole is exposed to a current of air to dissipate the moisture. Resins washed in this manner, and well dried, are much fitter for the composition of varnishes than those which have not been subjected to the same operation.

A few more precautions are still necessary in composing delicate varnishes, such as those designed for valuable paintings and other objects of luxury. It will be proper to separate the pure resinous tears from those which are stained, or which are accompanied with portions of the bark of the tree that produced them.

On the necessity of a reduction in the formulæ.

Watin seems to be the first author who was fully sensible of the necessity of reducing the formulæ to a small number of substances. But, notwithstanding the advantage attending this step towards improvement, many things of importance still remain to be done. By prosecuting, for example, a series of experiments on the different resinous substances with spirit of wine of a known degree of purity, a table of solution might be formed, which would be exceedingly useful to the operations of the varnisher; because, by knowing the kind of resin about to be employed, and the degree of the purity of his spirit, he could immediately determine the quantities of the substances proper for the intended composition. There are, indeed, some resins more soluble in spirit than others.

Of the choice of the matters.

The goodness of the varnish depends not only on the choice of the soluble matters, but also on the state of the liquors in which they are to be dissolved. A varnish may be of an inferior quality, though the vehicle has dissolved as much resin as it can take up. The excel-

lence of spirit of wine cannot be determined merely by the sight; and for this reason I have enlarged on the best means, as a guide to the artist and amateur on this point, which is of the utmost importance.

A knowledge of the nature of essential and fixed oils is also of importance. Their smell, colour, and consistence, are signs which may determine the artist's choice. To these may be added, in cases of uncertainty, the indications we have given in treating of each of them separately *.

Such are the guides in which the artist ought to place confidence in regard to the composition of varnish: by these alone he can hope to obtain success. But whatever efforts may be made to produce a *maximum* of solution in the mixture of the matters, he can attain only to a point of saturation proportioned to the nature of the resins, and to the present state of the liquors employed.

* It is scarcely possible to determine accurately when any fixed or essential oil is quite pure; if, however, an essential oil has a fat oil mixed with it, as the first is usually soluble in rectified spirit of wine, if, on being poured into the spirit it does not dissolve in it, but makes the spirit foul, and leaves ultimately a gross sediment, we may be certain that the essential oil has been adulterated. But there does not exist any known method of proving definitively when one essential oil is mixed with another, as sometimes is the case with oil of lavender, that being occasionally deteriorated with oil of rosemary, except by its altered or impure smell; nor is the difficulty less with fat or expressed oils. If, however, an essential oil is diluted with rectified spirit of wine, as it sometimes is, when such diluted oil is poured into water, the whole mixture will become turbid, and more or less milky.—EDITOR.

Of the respective proportions of the dry and liquid substances employed in the composition of varnish.

The art, however, is still imperfect, if the practical part be confined merely to the choice of the substances. Too great a number of them, as well as too great proportions, will disappoint the artist in his expectations. By simplifying the compositions, and reducing them to a small number of substances, it is easier to follow the effects, and to discover the causes of them: research then becomes less painful and less expensive. A great deal has been done in this respect, and for the most part in a wrong direction; but as long as artists were the only guides and regulators, the success was very doubtful. If the celebrated artist whom I have often quoted was able, by his judicious observations, to make people sensible of the utility, and even the necessity of reformation, and of reducing the formulæ to a small number of substances, he did not place the art beyond the need of further advice: more was necessary to be done, by reducing the number of matters, and reducing also the proportions.

In general the best rectified spirit of wine will not dissolve more than a third of its weight of resinous substances, even when the most soluble are chosen. A boiling heat may cause the spirit to dissolve more, but on the removal of the heat the varnish becomes turbid, and some of the resinous matter is precipitated, or, under the form of a crystallization, lines the interior sides of the vessel. Some of the formulæ given in the best works still prescribe, in dry matters, a weight equal

to two-thirds of that of the solvent. The proportions indicated in the different formulæ given in this work are more than sufficient for the prescribed quantities of liquid; since there still remains a considerable part which escapes its action. In all cases, the process is less embarrassing, and more secure from those accidents which are the consequence of a mixture too much charged, and which forms a mass; and is certainly less expensive.

On the effects of the mechanical division of resins which oppose the greatest resistance to solution.

Some resins, such as gum sandarac, copal, &c. resist more than others the action of the dissolving liquors. Copal, in particular, exhibits this character. This difficulty, however, may be overcome, with greater or less ease, by diminishing the proportions of these substances. Simple mechanical division, carried as far as possible, and the mixture of a readily soluble substance, such as mastich or frankincense, facilitate solution in a degree which does not take place when the two substances are treated separately, and in the usual manner. Experience alone can determine in regard to this point. We have already seen that camphor produces a great effect as an intermediate substance, but the proportion must not be carried to excess.

Of the use of pounded glass.

When it is necessary to operate on a considerable mass of matters, the form of the vessel employed is of

some importance. Its capacity is not always suited to the quantity it is intended to contain. In this case, the first application of the heat tends to agglomerate the resinous ingredients, and thus thwarts the intention of the artist, whose utmost care should be to favour and maintain that state of division which promotes their speedy solution. This object cannot be accomplished by simple stirring, nor even by employing broad-bottomed vessels. But the consequences of this inconvenience may be greatly diminished by employing some pounded white glass, which has been sifted through a hair sieve. It must be mixed with the pulverized matter before it is united cold with the spirit of wine or the oil of turpentine; and the division of the parts may still be assisted by stirring it with a rod of white wood, rounded at the extremity. By this simple mechanism the matter is kept in that state of division necessary for the promptitude and perfection of the solution; and the tumefaction of the liquid, a circumstance much to be dreaded in the process of making varnishes, is prevented. Besides, the weight of the glass, which is greater than that of resins, makes it fall to the bottom of the vessel, where it prevents the adhesion of the softened matters *.

* Notwithstanding M. Tingry here proposes *white*-glass, to be mixed with the ingredients to promote the solution of the resinous substances, *green* or even *black* bottle glass must be equally efficacious. Nothing is said about the employment of *sand* in such processes, but there can be no doubt that clean coarse sand, consisting chiefly of silex, is equally as good as glass. Latterly, however, coarsely powdered *charcoal*, in the proportion of about one ounce to one pint of spirit of wine or of oil of turpentine, has been recommended instead of glass or sand. There are,

The use of a balneum mariæ is preferable to that of a sand heat in operations of this kind, because the temperature of the former has a certain fixed point of elevation, which is often exceeded in a sand heat; and in such case there will be great danger of discolouring the varnish, from the application of too great heat. After the operation, more or less of the resinous substance remains mixed with the glass. This residuum may be reserved for the composition of common varnishes, which are treated over an open fire.

Of clarification.

Where the matter of the composition does not exceed three pounds, an hour and a half will be, in general, sufficient to complete the solution of the resins, provided that, during this period, the water in the balneum mariæ has been kept in a state of ebullition. The circular motion with the stick must, however, be still continued for half an hour after the vessel has been removed from the bath. The whole must be then left at rest, to give the undissolved matter time to subside. Next day the clear liquor may be decanted, and put into proper vessels. Some artists strain the varnish, still warm, through a piece of linen cloth, and then leave it at rest for a few days to clarify.

In both cases, when it is supposed that the solvent is

however, some circumstances which indicate that charcoal cannot be on all occasions so useful as glass or sand; one of which is the difference in its specific gravity from both the last-named substances.—Editor.

completely saturated with resin, it must be left for some days at rest. By a high temperature the vehicle becomes charged with a greater quantity of the substances than it can retain when cold. The excess will be precipitated, either in whole or in part, according to the season. When the precipitation is pretty extensive, small lumps of resin are formed round the vessel; and sometimes the precipitated resin assumes a peculiar crystallization. Sometimes the precipitation is not so evident, the varnish remaining a long time turbid, in consequence of the excess of resin continuing in a state of suspension. When this occurs, add to it a warm solvent, which will dilute the varnish a little; or it may be filtered through cotton.

Of filtration through cotton.

This operation is simple. Arrange several funnels in as many appropriate receivers *(see Plate I. fig.* 4.), and place in the pipe of each funnel a small ball of carded cotton, about an inch in thickness; press this ball towards the point of the cone, to squeeze the cotton together, and place over it a small plate of lead pierced with several holes. Fill the funnels with varnish, and lay over the vessel a glass cover, or a few sheets of paper. The varnish which passes through the cotton is at first not very limpid; but when the cotton has imbibed a sufficient quantity, the liquor passes very clear. The first portion of filtered varnish is then to be poured again into the funnels; and the filtration being continued, the result will be a very bright varnish. This

filtration, which is soon performed, is indispensably necessary for every kind of varnish intended to be applied to delicate articles, such as cut-paper works, valuable furniture, paintings, philosophical instruments, &c. Care must be taken to keep the funnels full, and particularly not to leave the cotton uncovered; else it would become incrusted with a stratum of dry varnish, which might impede any further filtration.

When the whole is filtered, it will be proper to wash all the vessels with spirit of wine, or warm oil of turpentine, according to the nature of the solvent. The product of the washing may be kept in reserve till a new quantity of varnish is made.

On the preparation of varnishes in open vessels, and the precautions which they require.

The varnishes of which we have here given the different formulæ, are reserved only for articles of a certain value, and require particular care in the preparation. Those who prepare varnishes make other compositions which they intend, in general, for wainscoting, ceilings, common furniture, &c. Some prepare them in open vessels, and in the open air, in consequence of the accidents which sometimes take place when alembics are employed. It is indeed much easier to save a matter from inflammation which is seen to rise, than one inclosed in metallic vessels, where its tumefaction is not observed.

This labour on the first view appears to be easy. It, however, requires practice and perseverance to obtain

the required result without accident, and to quiet the well-grounded fears which those in the neighbourhood may conceive of the danger likely to arise from this process. It will be proper to perform the operation in the day-time, and in the middle of a spacious court or garden. The vessel ought to be furnished with high edges, that the torrent of vapours which escapes may not communicate with the undulating flame, which often extends beyond the fire-place. Care must also be taken to dispose the vessel in the furnace in such a manner as to cover the fire entirely, and to prevent any portions of the varnish which may be thrown up by a false movement of the spatula from falling into it.

The precautions to be observed, however, are not confined to the manipulations usual on such occasions. When the solution is completed, it is customary to deposit the varnish in an apartment, or workshop, to cool, and also to give it time to clarify. This apartment then becomes filled with inflammable vapour, to which fire may be communicated by an inflamed body. These vapours are the more dangerous, as they sometimes extend to a great distance, even beyond the apartment, so that the contact of a lighted taper may occasion an explosion which might ignite the evaporating substance itself. Great care must, therefore, be taken not to enter with a candle into an apartment which may contain vapours so highly inflammable.

Although the method of making varnish in open vessels has some advantages, it is not free from inconveniences. The artist, indeed, may carry on his operation

in more security: he can easily prevent the tumefaction of the matter, and, consequently, those accidents which result from it. By means of continued motion he can also supply the means of escape to the vapours in a state of expansion; and he may renew the surfaces of the resin which touch the bottom of the vessel, and which, by being altered, might discolour the varnish. This is the favourable side of the method; but I shall exhibit also the reverse.

This process occasions a very great loss of spirit of wine, or of oil of turpentine, in consequence of the vapours which rise from the mass. These vapours are the purest part, and contribute most to the excellence of the varnish, to its pliability and lustre. The effect which the constant vapour of the oil of turpentine may produce on the nerves of the artist exposed to it, ought also, if possible, to be avoided. However great may be the precautions taken in processes of this kind, as they have not always been sufficient to prevent serious accidents, this is sufficient to justify the fears of individuals who reside in the neighbourhood of the varnisher, and to excite the vigilance of the police to confine to the outskirts of cities all establishments of this kind. I consider it therefore my duty to obviate, or to lessen, by improving the form of the vessels and apparatus in the making of varnish, the dangers to which the varnish maker, as well as the community, is exposed.

See some observations on Sand-heats *and* Retorts, *in the concluding chapter of this work.*

Alembic for the preparation of Varnish

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Description of an alembic, or still, proper for the preparation of varnish.

In the common alembic, or still, the solution of resins cannot be rendered complete, so that those accidents which arise from the agglomeration of the resins, and particularly from an accumulation of confined vapour, can at the same time be prevented: for the matters becoming tumefied, raise up the capital, and spread with an explosion to the fire, often even to the artist, and in this manner occasion conflagrations. One of the results from the use of a common alembic, is the discolouration of the varnish, in consequence of an alteration which the resins undergo, by adhering to the bottom of the vessel. These effects would not take place if the construction of the alembic afforded the means of maintaining a circular motion, which would change the points of contact of the inclosed matters: and if, instead of fire being applied to these matters in an immediate manner, it were applied mediately, as is the case when a balneum mariæ is employed. These two conditions appear to be answered by the construction of the apparatus here described (*See Plate* 2. *fig.* 1.).

It is an alembic and a balneum mariæ with a refrigerator. It consists, 1st, of a common alembic; 2d, a balneum mariæ; 3d, a capital: 4th, another separate piece which performs the office of a refrigerator, and which is adapted to the alembic at the moment of the operation.

The alembic *a*, fig. 1, is of copper, and made in the

usual form; the aperture, *b*, terminates, in a tube, intended to receive the pipe of a funnel, for the purpose of affording an escape to the vapours which arise from the water in a state of ebullition. This piece then serves as a receptacle for the water of the balneum mariæ.

To this alembic is adapted the balneum mariæ *c*, made either of tin or of copper; it has the same form as that of the common alembics, and serves to contain the substances which are to compose the varnish. The bottom of it is horizontal, perfectly flat, and about an inch less in diameter than the mouth. The upper part of this piece is strengthened by a circular band, which serves to cover the joining where the capital is fitted to the alembic. To save expense, this circular band may be made of lead.

The diameter of the capital, *d*, at the base, is proportioned to that of the balneum mariæ, in such a manner as to join with the circular band. This piece terminates in a dome, which at the summit has a pipe or aperture *e*, half an inch in diameter. A metallic bar, *f*, fig. 2, soldered at the two extremities, and pierced with a hole corresponding in a vertical direction with the aperture *e*, and having the same diameter, passes through the middle of the lower end of the capital. These two apertures are to keep in an exact vertical position a small rod of iron, *g*, connected on the outside with the handle, *h*, which is of wood, and moveable. The lower part of this rod, which is continued to the bottom of the balneum mariæ, is furnished with an iron cross, *i*, cut into teeth, while its two extremities are raised up, as seen at

k: the lower part represents an inverted L. *See fig.* 2 *and* 3.

In the upper part of the capital, *d*, is formed a second aperture, *l*, which terminates also in a tube, capable of containing a cork stopper. This aperture is for the re-introduction of the parts of the liquid obtained by distillation.

A conducting tube, *m*, the diameter of which is twice as large as that of the beak of common alembics, taking into account their capacity, proceeds from one of the sides of the alembic. It is by this canal, which is made of a sufficient length, and which is of an equal diameter throughout, that the refrigerator *n*, is connected with the alembic.

The refrigerator, *n*, is constructed in such a manner as to afford a free passage to those matters which might become tumefied, or to condense the vapours which escape from the interior part of the vessel. Both these ends may be accomplished by means of a plain wooden box, well joined together, of an oblong figure, through which a tube, *o*, made of copper, tin, or tin-plate, passes in an oblique direction. This tube, throughout its whole length, is of the same diameter as that which proceeds from the capital, and is only a continuation of it. When used, the box or trough is filled with cold water.

The extremity of this tube terminates in a bent part, *p*, of the same diameter as the rest. Under this part is placed the vessel, *q*, intended to receive the product of the condensed vapours, and, in case of need, the matters which may be raised in the interior part of the appa-

ratus, by the effect of the heat, or in consequence of the consistence which the liquid acquires in this kind of operation, or by the negligence of the artist to stir it during the process.

This alembic is placed on a portable furnace of burnt clay, *r*, or on a fixed furnace constructed of bricks, or other materials: it ought not to be too high, lest the artist should be incommoded in managing the handle, *h*. It has the same form as other furnaces, and is only modified in the manner of placing the chimneys, or vent holes, which ought to be so disposed as to be sheltered from the contact of the inflammable matters, that may fall on the edge of the furnace. This end may be obtained by making the apertures of these chimneys issue through the sides of the furnace, at the distance of two or three inches from the upper edge, and forming over each of them a small projection. The same purpose will be answered by placing on a common furnace a ring, the edge of which, *s*, extends about an inch beyond the exterior diameter of the furnace. This ring supports the alembic. It may be made of burnt clay, or of soft stone.

Remarks.

Distillation is a process so common, that any one may conduct it; but when applied to the present object it requires, on the part of the artist, more attention and more care than in ordinary cases. The following, then, is the conduct which should be observed in the preparation of varnish, according to the method here proposed:—

When the matters are put into the balneum mariæ, cover that part with its capital, and cause the agitator to touch the bottom of it. Lute the two parts exactly, at the place where they are united, with bands of paper and flour paste. Then make a few turns with the handle before heat is applied, to divide the matter; keep the tube *b* of the alembic open, and shut closely the tube *l*. Adapt the refrigerator to the alembic, and cement a few slips of paper over the place where the two vessels are joined; introduce into the alembic such a quantity of water that the body of the balneum mariæ may be half immersed in it, and then kindle the fire.

It is of some importance to move the agitator at the moment when the fire is kindled. If this precaution be neglected, the resinous matter forms itself into a mass, and in that state opposes more resistance to the action of the vehicle. Continue the rotary motion during the whole process, but without too much precipitation. The solution, to be complete, requires only an hour, or an hour and a half, reckoning from the moment when the water begins to boil.

If the level of the water employed be fixed at half the interior height of the balneum mariæ, or a little higher, the inconveniences attending too great a quantity of that liquid will be avoided. By the force of ebullition part of it is thrown up through the tube, and often incommodes the artist; but there is still a greater inconvenience. When the balneum mariæ is thus completely surrounded with a boiling liquid, the vapour of which has not the means of free escape, the spirit, which be-

comes hotter as it acquires greater density, in the ratio of its union with the resinous part, tumefies, and escapes as it boils up through the apertures which it meets with: and if it should unfortunately experience the least obstacle to its forced emission, it would burst the vessel, and inundate the artist with matters, which being soon inflamed by their vapours coming into contact with those that fall into the fire, would expose him to the danger of losing his life in the most excruciating pain, as has frequently been the case.

If the kind of alembic here described were designed for various other uses, like those in chemical laboratories, there might be reason to apprehend the effects of some negligence in regard to the care that ought to be taken to keep the tube *b* open, when the distillation is carried on with a balneum mariæ; and to close it with a stopper when distilling with an open fire, that is to say, without a balneum mariæ. For the present purpose there is never need of employing this alembic on an open fire: consequently the artist is not under the necessity of shutting the tube, and by these means he avoids those accidents already mentioned. In the contrary case, the vapours of the boiling water being accumulated, and finding no way of escape, would soon burst the apparatus, or would exercise a still greater action on the matters in the bath than if the alembic were filled with boiling water.

In proportion as the heat acts on the substances inclosed in the balneum mariæ, it unites itself to portions of the vehicle, which it reduces to vapour. A part of

these vapours are condensed in the inside of the capital, and fall back on the matter. Another part, escaping from the interior of the apparatus, is condensed in the lateral tube, which traverses the refrigerator, and proceeds in a liquid form into the receiver. This product is composed of the most volatile and the most subtile part of the liquid employed for the solution. This loss, if considerable, diminishes the power of the alcohol not volatilized: in a word, the quality of the varnish would suffer by it, if the product of the distillation, when a certain quantity is collected, were not restored to the mass. The aperture *l* is then opened, and a funnel of tin plate is adapted to it, through which the liquor that has escaped in the form of vapours is returned to the varnish. The cork stopper is again put in its place; and the circular motion of the agitator is continued. I think it needless to recommend the utmost care that no portion of the liquid introduced may be suffered to fall into the furnace: artists must be well aware of the consequences.

Several compositions require the use of turpentine; but it must not be put into the bath at the same time as the resins; because it would combine with the spirit, and prevent it from exercising the requisite energy on the other substances. The mixture of it must, therefore, be deferred till towards the end of the process. It may be easily added, by first melting it over a slow fire, and introducing it in the same manner as the product of the distillation. A portion of the distilled alcohol should be reserved for washing the vessel which con-

tained the turpentine, and the funnel which has been employed.

When it is judged that the solution of the resinous matters is finished, the whole of the fire must be removed from the furnace, and the circular motion of the agitator continued for half an hour, leaving some intervals of rest. When the apparatus has in some measure cooled, a sponge dipped in water may be drawn over the pieces of paper which cover the joints; and they are then to be removed as well as the capital, which has been separated from the refrigerator. The varnish being then decanted into proper vessels, it may be strained through a piece of dry linen, or filtered through cotton.

This operation ought to be performed in the day time, lest the inflammable vapours which may escape should be set on fire by the candles. The artist, who undertakes this labour with the precautions pointed out, will always be secure from those accidents which, in this process, are attended with such dreadful effects.

It ought always to be remembered that *spirituous* varnishes never should be prepared in larger quantities than may be required for immediate use, because they do not long retain those qualities which render them valuable. They should also be kept in well stopped vessels, much of the spirit escaping from them quickly when exposed to the air. When too long kept, they become yellow and greasy. In this respect they are very different from oil varnishes, which improve by time. For farther observations on the application of heat, and particularly the heat imparted by STEAM in the preparation of varnish, see *the next chapter*.

CHAPTER VI.

Farther observations on the application of heat, and particularly the heat imparted by STEAM *in the preparation of varnish. Various formulæ for the preparation of varnish not in the former editions of this work.*

WHEN the work of M. Tingry on varnishes was first written, the application of heat by the means of STEAM in processes connected with the arts, was scarcely if at all known; and hence it was not possible for him to apply STEAM to the processes of varnish making. There is no doubt, however, that any ingenious artist may apply that agent very successfully in the solution of many substances which enter into the composition of varnish.

It is not, however, very probable, that steam can be employed beneficially in the composition of *spirit* varnish, where a heat at or below the boiling point of water, namely 212° of Fahrenheit's thermometer only is wanted, or is necessary, chiefly because the application of such a heat is very easily obtained by ordinary means. But where a heat *beyond* the boiling point of water is wanted up to 300°, or more, there can be no doubt that steam offers a very useful medium for such

purpose; principally in being applied to solutions of copal in fixed oils and other bodies, which a slight heat will not render gaseous. But it should be religiously borne in mind by the varnish-maker, that the application of a boiling heat to varnishes, containing alcohol, ether, or even oil of turpentine, will be always attended with more or less danger, in consequence of the gaseous expansion of such bodies, and therefore the utmost caution is necessary when treating these substances for varnish. Hence the invention of the apparatus or alembic, for the condensation of the spirit described in the last chapter.

But when copal and amber are melted alone in open vessels, a much greater heat than that of boiling water is usually employed to liquefy them, and in consequence it must often happen, through the uncertainty in the application of such heat, that those resinous substances become more or less coloured, besides being often injured in their qualities. Now as such a heat only is wanted as will merely melt those bodies, the heat supplied by steam presents, we presume, a very convenient agent for this purpose; and we do not doubt that those engaged in making varnishes, particularly in the large way, have already availed themselves of the assistance of such an agent. But as all such processes come, at present, under the denomination of *secrets of art*, we cannot expect that any one interested in them will favour the public with an explanation of the particular means which he employs in his processes; at the same time we are quite convinced, that any one with a moderate capacity and a

knowledge of what will be found in this volume, and in that entitled the *Painter's and Colourman's Complete Guide*, now published as a separate work from this on varnish, will find no difficulty, with the assistance of his copper-smith or tinman, in obtaining an apparatus for the preparation of varnish by means of steam, which must be very beneficial and profitable in the art. For small quantities of varnish it is not probable that such apparatus will be sought, and therefore, in such cases, the usual known methods of applying heat will be still no doubt adopted.

Fixed oils in particular may be made much hotter than the boiling point of water by steam, without the least danger; and where fixed oils are employed in large quantities in the manufacture of varnish, such a method will not be lost sight of by the varnish-maker. In some of the directions given by M. Tingry, the oil is directed to be made *boiling* hot, in order to be mixed with the melted resins, but the degree of 600° of Fahrenheit is by no means necessary for such oil; a much lower one will be found equally efficacious: such oil must nevertheless be sufficiently hot not to coagulate the melted matter.

But it must not be for one moment forgotten by the varnish-maker, that although, as we have said, the fixed oils usually require the heat of 600°, or at least above 580°, to boil them, it is also true that long before they approach that degree of heat, many of them give out *inflammable vapours* which will ignite on the approach of a burning body. From experiments made

with fixed oils, and detailed by various chemists as witnesses at a celebrated trial, *(Severn, King, & Co.*, versus the *Imperial Assurance Office,)* it appears that at 375°, or even lower than that, (after the oil had been repeatedly heated,) a highly inflammable vapour was given out; and therefore in employing the fixed oils in the making of varnish, it is evident that great care and circumspection are required. We do not deem it necessary to enlarge further here on this important subject; but refer those whom it more immediately concerns to the report of the trial itself; or rather to an useful abstract of the chemical portion of it in the first volume of the *Journal of Arts*, page 188, entitled, *On the volatility and inflammability which fish and other fixed oils acquire by continued exposure to certain high temperatures.* The varnish-maker will not fail to derive considerable instruction from this paper.

It may be useful here also to observe that, although the statement made by M. Tingry, page 58, that "the best spirit of wine rarely becomes charged with more than a third of its weight of the resinous substances subjected to its action;" yet it is also true that most of the resins when pure may be mixed by a careful application of heat with spirit of wine, in various proportions. Thus, as is well known, shell lac may be mixed with rectified spirit of wine, so as even to retain a considerable degree of hardness, in addition to its tenacity, and forming the best sealing-wax, with, of course, vermilion, and a certain quantity of camphor; the camphor being however added in order to make the wax burn well, on

which its quality, as sealing-wax, in addition to its tenacity and colour, depends. So also if it happen that a spirit varnish be exposed to the air, it soon becomes a thick balsam, and merely requires the addition of spirit of wine to give it its customary limpidity. We mention these facts here that the varnisher and varnish-maker may be enabled to avail themselves of every circumstance, a knowledge of which is useful in the art.

It is obvious, therefore, that a *red spirit varnish* may be made with the same ingredients which constitute red sealing-wax, by merely varying the proportions of the spirit of wine. As this red varnish may interest some persons, we here give what we know to be an excellent formula for red sealing-wax; when it is wanted to be employed as a varnish, nothing more will be necessary than to add a larger quantity of rectified spirit of wine. But it should not be forgotten that the specific gravity of the vermilion being much greater than the other ingredients, if the varnish be made *thin*, the vermilion will necessarily be precipitated.

RED SEALING-WAX.

Take of Camphor, 4 ounces.
Venice turpentine, 2 pounds.
Vermilion, $1\frac{1}{4}$ pound.
Rectified spirit of wine, 16 ounces.

Dissolve the camphor first in the rectified spirit of wine in a suitable vessel, over a slow fire, taking care that no flame touches the evaporating spirit; then add the shell

lac; and when that has become of an uniform smoothness by a moderate application of heat, add the Venice turpentine, and lastly the vermilion, which should be passed through a hair sieve held over the melted mass, in order that it may not get into clots. When the whole is well incorporated, it is ready to be formed into sticks of whatever size may be desired.

It may just be added, that it is usual to weigh out the soft wax into balls, and roll them on a mahogany table into the lengths desired, and then to flatten them by mere pressure. They are polished by being held over a charcoal fire in a chaffing-dish, then drawn over a bit of mutton suet or tallow candle, and rubbed with a piece of soft leather.

BLACK SEALING WAX

is made in a similar way, but, instead of vermilion, *lamp black* is employed. *Black resin* is also often used in about one third the quantity of the shell lac, thus:

Take of Camphor, 1 ounce.
Shell lac, $2\frac{1}{2}$ pounds.
Black resin, $1\frac{1}{2}$ pounds.
Oil of turpentine, 8 ounces.
Rectified spirit of wine, 8 ounces.
Lamp black, 4 ounces.

Dissolve the camphor in the rectified spirit of wine, then add the shell lac, to which pour the resin previously melted, and mixed with the oil of turpentine; using, of course, a moderate heat, and taking care that no flame touches the melting matters.

Remarks.

It is obvious that such forms may be varied almost to infinity; and it is also obvious that a *black*, and very useful *varnish*, may be made, by adding at pleasure either rectified spirit of wine or oil of turpentine, as may suit the taste or interest of the varnisher. But if *lamp black* be employed in such forms for varnish, it will be always most advisable to *burn it*, as described in p. 132 of our *Painter's and Colourman's Guide*, before it is mixed with the ingredients for a black varnish.

It may be also useful to observe here, that the Venice turpentine, when employed as above for a red varnish, should not contain a fixed oil, unless it has been previously made drying by some of the processes described in a preceding chapter of this work. The following formulæ are, we believe, equal to any foreign Venice turpentine which may possibly be obtained, and are well calculated for mixing with most of the formulæ described in this work.

ARTIFICIAL VENICE TURPENTINES.

Take of Frankincense, $3\frac{1}{2}$ pounds.
Oil of turpentine, $2\frac{1}{2}$ pints.

Melt first the frankincense over a moderate fire, then add gradually the oil of turpentine, and strain the whole while hot through a hair sieve.

Or, Take of Black resin, 8 ounces.
Oil of turpentine, 8 ounces.

Melt first the resin, and add carefully afterwards the

oil of turpentine: if it be required thinner, add more oil of turpentine.

Or, Take of Frankincense, $3\frac{1}{2}$ pounds.
Oil of turpentine, $1\frac{1}{2}$ pint.
Linseed oil, 1 pint.

Melt and mix as before, taking care that the oil of turpentine and linseed oil have been previously mixed.

Remark.

In this last form, the varnish-maker should be careful to employ a linseed oil which has been previously rendered drying.

TURPENTINE VARNISHES.

Of turpentine varnish, these general observations may be made. When such a varnish is wanted, without any regard to its tenaciousness when dry, the first preparation, as Venice turpentine above, becomes a very good varnish; if it should prove rather too thick, it may be readily made thinner by the addition of oil of turpentine. But if a varnish of a light colour be wanted, united also with some tenacity, the last preparation for Venice turpentine will be found the best. The forms for turpentine varnish may be multiplied without end; but from what has been said, the artist will know how to vary them to suit his interest, his taste, and the permanence of his workmanship. See pages 76 and 77.

FRENCH POLISH.

Take of Seed lac, 6 ounces.
Gum juniper, $1\frac{1}{2}$ ounce.
Gum mastic, 1 ounce.
Rectified spirit of wine, 32 ounces.

All the ingredients should be first reduced to a coarse powder, and then mixed with the rectified spirit of wine, in a vessel which will contain double the quantity, in order that, on being exposed to the moderate heat of a sand bath, or other moderate heat, room may be given for the expansion of the spirit without bursting the vessel. The mixture should be well shaken at least once a day, taking care, at the same time, to loosen the cork during the shaking: a few days will be sufficient to dissolve the resins. The application of this polish is too well known to every one conversant with furniture, and therefore need not be here described.

Some persons order equal quantities of shell lac and seed lac; but for this variation there can be no necessity: indeed, where brightness of colour is wanted, the seed lac is undoubtedly to be preferred; but for want of seed lac, shell lac may be employed.

We doubt, too, as in many instances of the formulæ for varnishes, whether so many ingredients be at any time necessary; and we think it very probable that the gum juniper in the above form may be advantageously omitted.

We may just add here, that two

Methods of freeing lac varnish from the reddish brown colour which is natural to it,

are published in Vol. XLV. of *the Transactions of the Society of Arts;* one by Mr. G. FIELD, consists in dissolving the lac in rectified spirit of wine, and then destroying the colour by repeated and careful additions of chlorine in vapour and of chloride of potash.

The other method by Mr. LUNING, is to add to a solution of lac, in rectified spirit of wine, animal charcoal, by which the same result is obtained.

BALSAM OF CAPIVI, OR COPAIVA.

has been lately proposed as a simple varnish, and it will no doubt answer the purpose as such; but we are not aware that it is superior to some of the best turpentines, to which it is in sensible, as well as other qualities, closely allied.

Balsam of copaiva is the juice of a tree, the *copaifera officinalis*, which grows in South America and some of the West India Islands. It is usually obtained by boring the tree to the pith, near the base of the trunk, whence it flows clear and colourless, and of the consistence of oil. It has a peculiar odour and a hot bitter taste. By exposure to air it becomes hard like resin. It is completely soluble in alcohol and ether, but insoluble in water. It is often adulterated with oil of almonds, and in this state must be totally unfit for varnish. See *Transactions of the Society of Arts*, Vol. XLIII.

ARTIFICIAL ASPHALTUM.

It appears, by a paper communicated by Mr. TURRELL to the Society of Arts, (*Transact.* Vol. XLIII. p. 58,) that Syrian asphaltum is the usual substance employed by engravers as an *etching ground* — that *coal tar*, by gentle evaporation, assumes the appearance of mineral pitch, and at last, by a continuation of the process, attains the consistence of asphaltum. This artificial asphaltum is found to answer nearly all the purposes of the natural production in the

COARSE BLACK VARNISHES,

such as are used for coach tops, various japanned wares, and other common articles which require protection from rust. The artificial asphaltum has a feature so nearly resembling the natural, that it is difficult to distinguish them by external inspection; the artificial is, however, blacker than the real asphaltum: the most certain method of detecting the difference between them, is by the *smell.* Artificial asphaltum must, however, be rejected for etching ground, as it contains ammonia, which will be affected by nitric acid. It appears also from this paper, that genuine Syrian asphaltum is the proper substance for etching ground; or *Burgundy pitch*, for such purpose, is scarcely less important. See, however, the form for etching ground in p. 63 of the volume above quoted.

Remarks.

We consider this paper of Mr. Turrell's of very great importance, and do not doubt that the very cheap article,

coal tar, which is produced in such abundance in the processes of obtaining gas from coal, will, when it becomes better known, answer for innumerable purposes as a common varnish, and also instead of pitch for the preservation of wood. Coal tar is already used extensively for the same purpose.

BLACK VARNISHES OF SILHET.

At Silhet, in Bengal, a black varnish is employed of singular lustre and durability. It is obtained from the expressed juice of the marking nut, *semecarpus anacardium* and that of the *holigarna longifolia*. Both these nuts contain, in their integuments, numerous cells, filled with a black resinous juice, which is found also in the wood of the tree. It is used as an indelible ink to mark cotton cloth; the colour is fixed by quicklime. The artisans of Silhet combine the juice obtained from both these nuts for a varnish; it is soluble in alcohol, but not at all in water.—See *Journal of Science*, Vol. X. p. 315.

CAOUTCHOUC VARNISH.

Melt the caoutchouc in a close vessel, that it may not inflame; it will require nearly the temperature to melt lead; it must be stirred with a horizontal agitator, rising through the vessel, to prevent burning. Oil of turpentine should be carefully added to it, which will render it easily applicable, and leaves the substance, when dry, a firm varnish, impermeable to moisture. This is an excellent varnish for preserving iron and steel from rust: the varnish may be at any time removed by a soft brush

dipped in warm oil of turpentine.—*Journal of Science*, Vol. XIII.

VARNISH FOR AIR BALLOONS.

A solution of caoutchouc in five times its weight of oil of turpentine; and this solution, mixed with eight times its weight of drying linseed oil, by boiling, forms the varnish usually applied to air balloons. See p. 108.

CAOUTCHOUC VARNISH, WITH NAPHTHA.

Digest one ounce of caoutchouc, cut into small pieces, in thirty-two ounces of naphtha. When it is dissolved, strain the varnish through a linen cloth.

Naphtha is a native, pungent, oily, odoriferous liquid, either colourless, or of a pale brown tint, found in springs on the shores of the Caspian Sea, in Sicily and Italy, and also near the town of Raynagoong, in the Birman empire in Asia; in which last place it is obtained in very large quantities, from wells specifically dug for the purpose. It is used in all parts of that empire for burning in lamps, and, when mixed with resin, for impregnating the timber of houses, the bottom of boats, and other purposes. The wells are about 160 feet deep: the naphtha, which is of a greenish colour, oozes from the sides of the well, and is drawn up by buckets, in a pure and liquid state. The produce of the wells is prodigious.

As, however, native naphtha is not a common article in this country, it is not probable that much use will be made of it, except for particular purposes. Still we think it probable that it may become an useful vehicle for cer-

tain varnishes. From an analysis of Persian naphtha, by Dr. Thompson, its specific gravity was 753; it boiled at 320°, and its constituents were 13 atoms of carbon and 14 atoms of hydrogen, with a small remainder supposed to be nitrogen.—*Journal of Science,* Vol. IX.

Remarks.

Native naphtha does not differ very much from the oil obtained by distillation from coal tar, except by its greater purity and lightness. Hence, of course, the oil of tar, for *common* varnishes, may be employed instead of this native oil.

BRUNSWICK BLACK.

Take of Asphaltum, 2 pounds.
Boiled linseed oil, ½ pound.
Oil of turpentine, 2 pints.

Melt first the asphaltum, to which add the linseed oil, and afterwards the oil of turpentine.

Remarks.

This is an useful varnish for grates, and other common purposes; it is best applied warm, or even hot.

BLACK JAPAN VARNISH.

Take of Boiled linseed oil, 4 pints.
Burnt umber, in powder, 4 ounces.
Asphaltum, 3 ounces.
Oil of turpentine, a sufficient quantity to make the varnish of a proper consistence.

Melt first the asphaltum, to which add the linseed oil gradually, it being first made hot; next add the burnt umber, and, lastly, the oil of turpentine.

Remarks.

This will be found most useful as a varnish for *leather.*

LINSEED OIL A VARNISH.

If linseed oil be rendered drying by digesting it upon an oxide of lead, and afterwards applied with a small brush on any surface, and dried by the sun, or in the smoke, it affords a pellicle of considerable firmness, transparent, burning like caoutchouc, and wonderfully elastic. A pound of this oil spread on a stone, and exposed to the air for six or seven months, acquired almost all the properties of caoutchouc. It may be used to varnish balloons, to make catheters, bougies, and for other purposes.—*Dr. Ure.*

WHITE HARD VARNISH.

Take of Gum Sandarac, 3 pounds.
Gum Anime, 4 ounces.
Rectified spirits of wine, 8 pints.

Let the gums be finely powdered, and then added to the spirit of wine, a little at a time, stirring the mixture. Put it into a two gallon can, in a warm place, stirring the mixture till the gums are dissolved, when it may be strained, and is fit for use.—*Whittock.*

SHELL LAC VARNISH.

Take of the best shell lac, finely powdered, 5 ounces.
Rectified spirit of wine, 2 pints.

Place the mixture in a gentle heat till the shell lac is dissolved.—*Whittock.*

COPAL VARNISH, WITH CHIO TURPENTINE.

Take of Powdered copal, 4 ounces.
Genuine chio turpentine, 8 ounces.
Oil of turpentine, sufficient to make the whole of the consistence of a varnish.

Melt first the chio turpentine, to which sprinkle in the powdered copal, and keep stirring till the whole is melted. Add, lastly, the oil of turpentine.

Remarks.

The proportions of copal and chio turpentine may be of course varied; but it is best not to add the copal in too large quantity.

SHELDRAKE'S COPAL VARNISH.

Take of Copal, broken into small pieces, 2 ounces.
Spirit of ammonia, 2 ounces; or camphor, 2 drachms.
Rectified oil of turpentine, 1 pint.

Stop the vessel with a cork cut in grooves, to admit a portion of the heated vapours to escape; bring it to boil over a brisk fire, so that the bubbles may be counted as

they rise; keep the mixture at the same heat: for if the least irregularity, or overheating, takes place, it is useless to proceed. When the solution is complete, let the vessel be quite cool before it is opened.

Remarks.

We give this form as it has been given, we believe, by Mr. Sheldrake. But it is obvious that it is, in many respects, a very inconvenient process, and requires more care and circumspection than the varnish-maker will be, perhaps, disposed to bestow upon it. There is no doubt, however, that a good and colourless varnish may be by such a process obtained.

The vessel which Mr. Sheldrake recommends is of tin, or other metal, strong, shaped like a wine bottle with a long neck, and capable of holding two quarts.

ANOTHER COPAL VARNISH

May be made by simply pouring upon pure copal, reduced to a fine mass in a mortar, colourless oil of turpentine to about one-third higher than the copal, and triturating the mixture occasionally in the course of the day; the next morning it may be poured off for use. Successive portions of oil of turpentine may be mixed with the copal, and will become charged with it as a varnish.

Concluding observations.

We cannot conclude this chapter without again calling the reader's attention to the necessity of employing

the greatest care and circumspection in the preparation of almost every kind of varnish; and more especially of those which contain ingredients which are readily converted into vapour by the application of heat. Not only are *rectified spirit of wine* and *oil of turpentine* liable to this condition, but the *fixed oils*, as we have seen, are also exposed to similar hazard when subjected to high temperatures; and therefore dangerous explosions, when they are much heated, may be the result.

We have no doubt that, in many of the processes of the varnish-maker, the agent of *steam*, as a new means of applying heat, particularly in the larger processes of varnish-making, may be usefully, safely, and advantageously employed, and we, therefore, again press this subject upon the varnish-maker's attention; concerning which an ingenious paper, by Mr. PERKINS, *on a newly-discovered system of generating steam*, was read to the Royal Society, May 3, 1832, and is well worthy the attention of persons who are desirous of acquiring the most useful and recent information concerning steam. The paper will, no doubt, appear in due course in the transactions of that learned body; but its substance will be found in the *Athenæum*, May 5, 1832.

CHAPTER VII.

Observations on the influence which the solar light has to render oil of turpentine proper for the solution of copal, so as to compose a durable and colourless varnish *.

HAVING undertaken a series of experiments on the solution of copal, and also on the effects of light on oil of turpentine, the present chapter will be devoted particularly to this useful and colourless solvent.

I announced in the article which treats of copal, that this substance is partly soluble in spirit of wine; that it may be entirely dissolved in it by means of an intermediate substance; that ether generally effects a solution of it, and in pretty large proportions, according to the state of the ether, and the particular nature of the copal; and that oil of turpentine has the same property, but with certain limitations, which seem to depend on a particular state of density.

* This forms the substance of a paper presented, in 1788, to the society formed at Geneva, for the encouragement of the arts, agriculture, and commerce, by M. Tingry.

This vehicle exhibits in its physical properties characters nearly similar to those of spirit of wine. Like that fluid, it is exceedingly limpid, liquid, and colourless. It possesses a mean density between that of spirit of wine and the density of essential oils: in this even it seemed to have with copal a more striking analogy, and which might lead to effects of solution that could not be expected from spirit of wine. I confided, therefore, with the more reason in the strength of this analogy, as the particular nature of the oil of turpentine permitted me to increase or to lessen its density at pleasure.

It was on these bases that I founded my researches. The first did not afford me complete satisfaction. I renewed my experiments; but the results still seemed to be very imperfect. I sometimes found that the oil of turpentine, which had exercised a partial action on the copal, produced no effect at a more elevated temperature. In other circumstances, the same liquid which refused to unite with copal, dissolved it readily after an interval of some weeks. At other times, mixtures of copal and oil of turpentine, kept in a state of infusion for twenty-four hours, without exhibiting any apparent solution, required only a maceration of some months to display all the characters of a complete solution of this kind, and at length of a beautiful varnish. I observed also, that of a certain number of matrasses, which contained mixtures of copal and oil of turpentine, in perfectly equal proportions, and which experienced no other difference but that arising from their position in different parts of the laboratory, several, some months after, exhibited all the

signs of a complete solution, while others showed no indications of it. I saw some also in which the copal remained under the form of lumps, covered with an amber-coloured liquor. I had, however, reason to think that the solution of the copal depended on a certain state of the constituent principles of the oil of turpentine. The following experiments were therefore undertaken; but I must observe, that I always made use of the same copal, in the state of powder, and of the same oil of turpentine.

Liquors susceptible of volatilization at a certain temperature, always exhibit in their ascent products the more attenuated, as they have required less heat, and, consequently, less time to be volatilized. Such is the case with spirit of wine, the first product of which is lighter than the succeeding.

Certain light essential oils are subject to the same law. By applying to the rectification of essential oil of turpentine the method employed for the rectification of spirituous liquors, dividing the products into several portions, I had reason to believe, that those which passed over the last would be less fluid, as well as less etherous. than the first.

I therefore divided into six equal portions the product of seventy-two ounces of oil of turpentine, distilled in a balneum mariæ. Each of these portions was put into a numbered flask, and the sixth flask received the residuum of the distillation. The flasks were closed exactly, and shut up in a closet from the light, where they remained nine months.

At the end of that period I found four of the flasks

covered in the inside with beautiful crystallizations, consisting of prisms grouped together in a divergent form.

No. 1 exhibited small needles, which crossed each other in every direction. They were transparent, and had a silky appearance. A great part of these crystals covered the bottom of the vessel; some also adhered to the sides, below and above the level of the oil. The most distinct of these crystals were $5\frac{1}{2}$ lines in length.

No. 2 presented two pretty large groups of prismatic crystals, diverging from a common centre. The largest were six lines, or half an inch, in length.

No. 3 showed only some rudiments of crystals, scattered over the sides of the glass above the level of the essence.

No. 4, besides small crystals adhering for the most part to the sides of the glass, above the liquor, contained three beautiful groups, in part divergent and crossing each other in different ways: most of these prisms were half an inch in length.

No. 5 presented no crystals but at the bottom of the vessel. They were, however, so numerous, that they covered the raised part of the bottom. Many of these prisms were insulated; others were disposed in divergent radii, in such a manner that one prism served as a base to four or five others, which adhered to it only in one very acute point. The largest did not exceed three lines.

No. 6, which contained only the residuum of the distillation, and which had a strong amber colour, exhibited no appearance of crystallization.

If these crystals really varied in regard to their dimensions, the case was not the same in regard to their form. In all of them I observed the quadrangular, flatted prism, with two large and two small faces. They were prismatic laminæ truncated horizontally. In some crystals the extremities were continued to a point.

These crystals, when taken from the oil, and exposed on brown paper to dry, have very little solidity. They dissolve in spirit of wine and in water, the limpidity of which they destroy. A little oil is separated from them, which floats on the surface. This effect arises, no doubt, in a great measure from the portion of oil with which they are still enveloped. The solution of this salt turns blue vegetable colours red. This concrete volatile salt almost always appears in an oil exposed to the influence of light, though no crystals are produced by cooling, or by its remaining in a cold place. In this case it is more disposed to fix itself above the level of the oil than below it. The process which accelerates its formation consists in making the oil pass over the upper and uncovered parts of the vessel. Evaporation has a considerable share in the production of the phenomenon. But, if a matrass, half filled with oil of turpentine, and which already exhibits crystals in the part not occupied by the oil, as well as in the bottom, be exposed to a hot sun, the former will almost always remain, and often even increase, while those covered by the liquid dissolve into a kind of reddish water, which falls to the bottom of the vessel. This water is exceedingly acid. It effervesces with alkalies, renders blue vegetable colours suddenly

red, and impresses on the tongue a caustic and burning taste. The salt which produces it appears to be of a benzoic nature.

The concrete, volatile, acid salt of the essence of turpentine, covered by the fluid which produced it, is susceptible, then, in this particular case, of dissolving in water, in consequence of the same cause which makes it appear on the free sides of the vessel. A temperature somewhat higher than that of the atmosphere would be sufficient to separate the acid from the oil, which serves as a basis to the crystals. I do not know whether these effects would be constant; but I observed them on the six bottles I had exposed to the sun; and I have since observed them in a great number of similar cases. This phenomenon of liquefaction, however, was observed in crystals which had been formed in the course of twenty-four hours above the level of the oil, and under the oil; and which I had kept some time in the cellar, in vessels closely shut: the crystals, which were dry, experienced the same fate as those immersed.

I did not extend my researches any further on the nature of this salt, the acid of which appears to me to approach very near to the nature of the benzoic acid; but, in the mean time, it may be defined an oily, acid salt, analogous to that extracted from balsams. The volatile salt of amber, perhaps, might be traced back to a similar origin; if its chemical properties be different, this may be ascribed to the influence of the mineral vapours, which for so many ages have been exercising an action on the resinous matter which constitutes amber.

The specific gravity of each of the numbered divisions of the oil was ascertained before I applied them to the copal. The tenuity of my specimens did not follow a progression corresponding to the period of their appearance in the course of the distillation. No. 4 had a specific gravity less than No. 1, and the latter was some grains heavier than the common essential oil of the shops, which had been employed for the distillation. The one last mentioned was to distilled water nearly as seven to eight.

The reader may judge of their degree of solvent power by the account of the following comparative experiments, which were all made in small new matrasses.

Ten grains of pulverized copal were mixed with an ounce of each of these separate oils. Each matrass, immersed in warm water, was kept for half an hour in a state of circular motion; but, under the present circumstances, this process, which in other cases was sufficient to dissolve 72 grains of copal in little more than an ounce of oil of turpentine, was not capable of carrying the solution, in each of these oils, to more than ten grains. No. 1 approached nearest to the limpid state which indicates a commencement of solution; the precipitate in it was less abundant. The other small matrasses, distinguished by a number corresponding to that of the flask from which the oil had been taken, showed the copal collected at the bottom in the form of a white glutinous mass, tough and tenacious. This toughness and tenacity, which are not commonly observed in the parts of copal treated with a lighter and more ethereous

essence, indicated, however, that these oils were disposed to operate the required solution. Under this supposition, I closed the matrasses perfectly, as well as the bottles containing the specimens, and left them for a year on one of the shelves in my laboratory. Their situation was such, in regard to the solar light, that they received it only by reflection during four or five months of the year. I waited a long time, and my expectations were not deceived. At the end of the year I examined the small matrasses, and the oils corresponding to them. The results exhibited by the former were as follow:

No. 1 was limpid, and showed neither residuum nor colour. A drop of water was at the bottom. I mixed with it ten grains of copal, after having exposed the matrass to a temperature of from 122° to 144° of Fahrenheit. The copal disappeared in a few minutes: forty grains, introduced at intervals, in quantities of ten grains, disappeared in like manner. The varnish thence resulting had a beautiful consistence, and showed, by its cloudy tint, that the point of saturation had been reached. Motion alone, without the aid of heat, was sufficient to complete the solution in a quarter of an hour. Here, then, by adding more copal to the first ten grains, I had fifty grains of that matter held in perfect solution in an ounce of oil of turpentine.

No. 2 was of a slight amber colour; the copal had disappeared, and there were separated from it two drops of acid, which, by re-acting on the oil, might serve to explain the origin of the tint assumed by the essence.

This specimen had also dissolved forty grains of pulverized copal, introduced at four different times.

No. 3 exhibited a tint somewhat more apparent than the preceding. Two drops of acid water had separated from it; but the liquid was, nevertheless, transparent. It had dissolved the same quantity of copal as the preceding.

No. 4 had still more of an ambery colour than Nos. 2 and 3. It contained also acid water. The same quantities of copal were attended with the same success as in the former cases.

No. 5 was cloudy; which I ascribed to some motion accidentally given to the matrass: the water was then mixed with the oil. It had the same tint as the preceding, and had dissolved as much as the former specimens.

No. 6 had a reddish colour, and I separated some drops of very acid water from it. It appeared to be the least proper for making varnish, as it was capable of dissolving only thirty-five grains of new copal, instead of forty.

All these specimens of varnish had the required consistence. They were exceedingly oily; extended themselves freely when applied under the influence of the sun; and, in summer, required only two days to form on ivory or on wood a solid and brilliant glazing.

It remained to be ascertained, whether the solution of the copal in the oil, contained in each of the small matrasses, which was very considerable, ought to be ascribed to a modification effected in the oil itself by the contact

of the copal, which had incorporated with it only slowly; and whether this copal, when once united to the oil, would not communicate to the latter the property of dissolving new portions of the resin. It was necessary, therefore, to apply to an ounce of oil, taken from each of the numbered specimens, the same quantity of pulverized copal, that is to say, fifty grains, using only ten grains at a time, as before. The following were the results:

The oil No. 1 could dissolve only forty-eight grains of copal, and the solution was turbid. No sediment was produced by two hours' rest; and the addition of one-eighth ounce of the same oil formed a varnish of a good consistence, and very clear. Some clouds only were observed at the bottom of the vessel.

No. 2 was treated in the same manner for the solution of the first forty grains of copal; but the last quantity introduced remained untouched. The varnish which floated over this sediment was turbid; and half an ounce of oil was required to make a varnish of it similar to the preceding.

No. 3 was like No. 1; but, after twelve hours' repose, there was separated from it a small portion, which might be estimated at two grains: the addition of a quarter of an ounce of the same oil, however, made it disappear.

No. 4 refused to unite with copal: the whole matter was precipitated, a few grains excepted. The oil had experienced no change in its colour or consistence. The copal formed a mass in it.

No. 5 gave, with fifty grains of copal, the same result

almost as No. 2; but no precipitate was formed at the time. The state of the solution, however, showed that it would soon appear. It was less voluminous than in No. 2; and only three-eighths of an ounce of new oil of turpentine were necessary to dissolve it.

If the specific gravity observed in the numbered oils be compared with their different degrees of power over the copal, we shall find that this power acts in the inverse ratio of their tenuity and lightness. The more distant, then, that oil is from the state of ethereous oil, the more energy it exerts on copal. This simple theory is sufficiently proved, first by the inactivity of the oil of the shops, which I tried before I subjected it to distillation; and then by that of the oil numbered 4, which we have examined.

To these examples might be added others taken from different experiments, the details of which are suppressed as unnecessary. The following result, however, deserves to be known: an oil which had no action on copal two months after rectification, took up forty grains per ounce eleven months after, and fifty-two grains at the end of eighteen months. The varnish was not more coloured than spirituous varnish prepared with the greatest care.

Was this owing to the effects of the light; or was it owing only to time, which, without any intermediate substance, disposes the oil to assume peculiar characters, which add to its specific gravity, and which render it more proper to dissolve that resin?

This is a question of so much importance, that it

deserves to be carefully examined. Some particular facts had familiarised me in some measure with the idea, that light had had some influence on the present results. It was therefore necessary to ascertain it in a direct manner. I consequently made researches on the subject, and I gave a detailed account of the results in a memoir inserted in the *Journal de Physique* for March 1798. These results prove that light alone was the cause of the phenomenon, and it is greater and speedier when the oxygen gas of the atmosphere has free access to it.

What takes place in oil of turpentine in which copal remains undissolved, may be considered as a new fact, the real cause of which can at present be only conjectured. Whatever care may be taken to favour the solution of the undissolved copal, either by the addition of an oil, or by the use of heat and motion, it remains entire, or the part made to enter into solution is so small as scarcely to be worth notice.

The same phenomenon is exhibited by varnishes which are only turbid. It would appear that copal contains two substances, the principles of which, differently modified, are, however, susceptible of an intimate combination, as seen in some bodies distinguished by the name of *resinous gums*, or *gummy resins*. It may also be proper to call the reader's attention to what takes place in a mixture of copal or of amber with spirit of wine, and with ethereous oil of turpentine. These liquors seize on a slight portion of these two kinds of resin; but their energy is confined in such a

manner, that if the vehicle of the first infusions be decanted, and its place supplied by a new quantity of liquor, the latter will exercise a still weaker action than the former, and so on in succession; because the part of these resins which is soluble by this kind of process has been extracted, or because what remains is so enveloped by the insoluble part, that it is secure from every attack.

Another phenomenon, which deserves no less to be examined, is the ambery colour which the varnish assumes when made with essence easily decomposed, and which readily yields water. The varnish speedily assumes colour, if by means of a few shakes the small drops of water adhering to the dome are precipitated to the bottom of the matrass. This water, which is acid, re-acts on the oily principle, and alters it.

Every oil of turpentine does not equally produce this effect; which seems to depend on its nature, and the strength of the acid it contains. Of seven matrasses containing this oil, of different degrees of density, and exposed on sand at a temperature of 200 degrees, there was only one which produced this effect. When similar oils are used, it will be proper to substitute a balneum mariæ for a sand bath, if a colourless varnish be required.

The facts observed in mixtures of oil of turpentine with a small quantity of copal, render it necessary to offer some observations on that subject. What, then, is the cause of this solution, which I have seen carried further on a small quantity of copal, with oils preserved in small matrasses, than with the same oils without mix-

ture? The former were able to dissolve fifty grains of copal per ounce; while the latter required the addition of a new quantity of oil of turpentine to take up from forty-eight to fifty grains. It will be recollected also, that this addition of oil of turpentine was made in the relative and inverse ratio of the density of the oil, which served as a basis to the experiment.

Two causes may concur to produce the effects observed in the matrasses charged with ten grains of copal. The first arises from the density of the oil. This density, acquired by the solution of a portion of the copal, extends to the oily body its quality of refracting the sun's rays. It disposes it to collect a greater quantity, to yield to their influence, and to acquire from them modifications capable of developing a certain analogy between the principles of its composition and those which constitute copal. The second cause may arise from the precipitation of their acid, which has followed the solution of the first grains of copal.

Light, such as it appears to our senses, possesses, in some respects, the same properties as heat, which has not yet been found to possess gravity; but, in combining with the matter, would it not add to the gravity of the latter? It was necessary to make new experiments on this subject. I did so; and though the results of them were foreign to the arts, they are so connected with the theory of the object which I undertook, that I do not think them susceptible of separation *.

* See the *Journal de Physique* for March, 1798; where the subject is treated in new points of view, and in a more extensive manner.

[*Here followed, in the last edition of this work, a detail of farther experiments made by M. Tingry, relative to the effects of light on oil of turpentine, but it does not appear necessary that that detail should be here given; what has been abstracted of the paper altogether will be sufficient for every practical purpose.*]

General consequences and conclusion.

The object of my researches, as already seen, was to verify a fact, known no doubt to some chemists, but which artists contest,—namely, the solubility of copal in an oil lighter and less coloured than fat oils,—in a word, in oil of turpentine.

The result of my experiments shows that this essence is the fittest liquor for making copal varnish; that an elevated temperature is not required to favour the process, since it is below that of boiling water. Mere stirring is even sufficient in summer. If the simplicity of this method be compared with that employed in the operation of uniting copal with fat oils, which cannot unite with it but when it is in a state of liquefaction, by the effect of a very high temperature, much superior to that of boiling water, it will be allowed that the liquor which may be employed at a temperature of from 88 to 100 degrees, aided by simple mechanical motion to effect that union, is the best of all for the intended purpose.

But my experiments show also that oil of turpentine does not always exhibit the qualities requisite for effecting this union. We have seen that ethereous oil had

absolutely no action on copal; that its dissolving property was manifested in the ratio of its density; that this density is altogether independent of the rectification of the oil by a second distillation, which in general gives only a light ethereous oil, if the operation is managed with care: or an oil, the specific gravity of which does not exactly follow the order of the division of the product, that light alone, by the effect of a particular combination, the mode of which can only be presumed, becomes the principle of this density, so essential to the solution of the copal, that this oil of turpentine, which at the moment of its rectification has exerted no power over the copal, may by the mere effect of the influence of light dissolve, after a certain time, the pulverized copal which has been precipitated from it untouched; that the copal even increases its energy, since the oil can dissolve a larger quantity of it than when it is exposed alone, and without any mixture of copal, to the same influence of light.

These results prove also, that the more the oil of turpentine is disposed to be decomposed, and to furnish acid water, in the course of the distillation, or during the time of the process for making the varnish, the less proper it is for the solution of copal; because this free acid reacts on the oil, and communicates to the whole mass a tint, which it ought not to possess; in a word, that this oil is susceptible of giving a concrete volatile acid salt, similar to that contained in certain balsamic substances.

The solubility of copal in oil of turpentine being once

ascertained, nothing remained but to make use of the observations scattered throughout this essay, in order to discover the speediest, and at the same time the most proper, method for making varnish with essence.

There was reason to think, that by dividing the products of one distillation of this oil into seven or eight parts, it might be possible to discover in these divided parts those which would exhibit the qualities requisite for completing the solution; but it was observed that this process at length gave a contrary result; since it often deprived the oil of the shops of that property which it might have acquired from time, or from any other circumstances. This distillation, however, is indispensably necessary when colourless varnish is required; when the oil of the shops is coloured. Besides, this operation, which may be performed on a large scale in manufactories, furnishes a very simple method of obtaining the most ethereous oil, the use of which I have recommended in the composition of varnish designed for valuable paintings.

If the distillation of oil of turpentine be undertaken with a view of accomplishing both these objects at the same time, it must be performed by means of a sand bath, taking care to cover the retort with a dome of burnt clay. From a hundred ounces of this oil ninety are to be distilled; the first forty of which, forming ethereous oil of turpentine, must be reserved for the composition of varnish designed for pictures. The last fifty ounces of oil are applied to the composition of copal varnish. The residuum even is not lost; it serves

for grinding and mixing up oil colours. If too thick, it is diluted with new oil.

From ten to twelve grains of pulverized copal are mixed with an ounce of the essence designed for varnish, and the mixture is shaken, immersing the matrass in a bath of boiling water. If the copal readily dissolves in the oil, new quantities are to be added; and this is continued till the oil takes up no more. It sometimes happens that this oil gives immediately a very beautiful varnish, and of a good consistence; at other times no solution takes place. In the first case the varnish is filtered through cotton, after it has been allowed to deposit the undissolved portions of the copal: in the second, that is to say, when the copal resists the oil, the matrass is closed with a cork, and exposed to the solar light until the oil of turpentine has acquired a more oleaginous consistence. It will assume this state the more easily, the greater the quantity of copal it holds in solution. The influence of the light gradually manifests itself on the oil, and the undissolved copal decreases in quantity, and at length disappears entirely. The consequence is, that the oil acquires from this matter, which is mixed with it, a new consistence and character, which dispose it to dissolve a greater portion of the resin; and in this manner to constitute a real varnish.

Oil of turpentine prepared in this manner ought to be preferred to the other vegetable oils, which approach nearest to the same state of density or of specific gravity. The varnishes, indeed, which result from the union of it with resins, are less fat, and of a more drying quality,

than those made with oil of lavender, oil of thyme, oil of rosemary, &c. employed directly or with some intermediate substance. They are also exceedingly durable when copal forms the basis of them; and they produce the most beautiful effect on metals and polished wood. Copal varnish made with oil of turpentine has a slight amber colour, which disappears after it has been applied. The oily character, which contributes to its solidity, disposes it, much better than spirit of wine, to dissolve those vegetable, resinous, and metallic colouring parts, with which the variety of colours that enrich transparent enamels can be imitated. It may be readily conceived, that to preserve the transparency of varnish, and to give it that lustre which completes the illusion, none but colouring matters entirely soluble in oil of turpentine must be employed.

To this abridgment of the paper of M. Tingry, it may be useful to add here, from the *Annales de Chimie et de Phys.* XIX. 279, the result of some experiments by M. VAUQUELIN, on the combination of alcohol with the volatile oils: namely, that 100 parts in volume of volatile oil of turpentine, and 20 parts of alcohol, mingled together, are not separable by repose, but form a homogeneous body. This effect is produced by a solution of the alcohol in the oil: for 1 part of alcohol cannot dissolve 5 parts of oil.

The above mixture, long and repeatedly agitated with water, was reduced to 108. The water thus deprived the oil of 12 parts of alcohol, and the oil retained 8, notwithstanding its long agitation with the water. Oil of tur-

pentine may, therefore, contain one-twelfth of its volume of alcohol, without our being able to perceive it, if it be not by the specific gravity, which is a little diminished. However, by repeated lotions, all the alcohol may be removed from the oil. The mixture of 100 parts of turpentine, and 20 parts of alcohol, does not become turbid by water; but when it is put over water, and slightly agitated, a portion of the alcohol is seen to separate, and to form in uniting with the water very perceptible *striæ*.

We consider the fact of the solubility of alcohol in oil of turpentine of great importance to the varnish-maker; and we doubt not that by employing both these vehicles in suitable proportions in making a varnish, that valuable additions to the formulæ of the varnish-maker may be obtained; and the solubility of copal and other resins be, by such mixtures, greatly facilitated.—EDITOR.

CHAPTER VIII.

Of the extent which may be given to the use of the turpentine copal varnishes by impregnating them with various solid colouring parts, transparent and proper for answering the purpose of glazing on metallic laminæ, smooth or ornamented; for imitating transparent enamel, and for repairing those accidents which frequently happen to enamelled articles.—Preparation of foils.—General observations on varnish, and particularly on the varnish of the Chinese.

[It having been determined to divide the work of M. Tingry into two volumes, for the accommodation of those who might choose either that on *Painting* or that on *Varnish-making*, it has been somewhat difficult to render both the volumes complete without repetition. This chapter, which belongs as well to painting as to varnishing, has been retained in the present volume, as being, it is conceived, more suitable to it than to that on Painting. For an historical account of the colouring matters employed in the formulæ of this chapter, the reader is respectfully referred to our volume, the *Painter's and Colourman's Complete Guide.*]

Residing in a manufacturing city, where the arts of enamelling and of painting in enamel have been carried

to a degree of perfection hardly to be met with but in Geneva, I have often witnessed the trouble, expense, obstacles, success, and uncommon activity which always accompany the first attempts.

The case with painting in enamel is not the same as with that which adds to the value of porcelain. The variety of the toys to which it is applied, their delicate forms, and the difference in the metallic alloys, require modifications in the compositions of the colours, and in that of the fluxes. These modifications, the necessity of which is sufficiently shown by the accidents that happen to enamelled articles, both in manufacturing, and when out of the hands of the workman, cannot be ascertained at a moment; and as there is, besides, no certain guide to direct the artist in his researches, a chapter on this subject will not be without its use.

Toys, when once they have gone from the hands of the artist, are no longer susceptible of being repaired; but means have been discovered of repairing the defects occasioned in certain opaque bodies, by small fragments broken from them; this is effected by cements possessing the solidity of a vitrified substance, which are afterwards painted and covered by a coloured varnish. In transparent enamel this reparation is more difficult. The tint of the varnish must correspond with that of the vitrified coating; it must possess the same splendour, and its solidity should be equal to that of the enamel itself. This may be accomplished by the ethereous copal varnish No. 17, and by those of Nos. 18 and 22. By introducing colours into the latter varnishes, which, by

their tints, imitate those prepared by vitrification with metallic substances, the reparation of the different accidents that happen to enamel is effected.

Simple copal varnish, or that made with turpentine, has an amber colour, which disappears when it has been applied. The oily substance, by contributing to its solidity, renders it very proper, and much better than spirituous varnishes, for mixing with certain vegetable resinous colouring bodies, by means of which the artist can, in a certain degree, imitate those colours which produce so beautiful an effect in transparent enamels. It may be readily conceived, that to preserve this transparency, which gives varnishes a resemblance to enamel, nothing must be employed but resinous or saline matters, entirely soluble in oil of turpentine. It was in this manner I prepared the colours applied to the lid of an ivory box, which I presented to the Society of Geneva, as a specimen of the new manufacture of coloured varnishes imitating enamel; and for which I was indebted to the gratitude of a fellow-countryman, for whom I had prepared the varnish.

The varnish serves as a glazing*, is susceptible of a fine polish, and resists the friction of keys, boxes, and other articles very often carried in the pockets, better than the vitreous flux of enamels. The daily use made

* To glaze, in the language of painting, expresses the application of a stratum of transparent matters on a coloured ground, in such a manner that the colour of this ground becomes more apparent, more brilliant, or lighter. To glaze, therefore, is to apply a colour which has little body, or a transparent tint, which suffers the ground on which it is placed to be seen.

of this box for twelve years, has destroyed the metallic ring which served it as an ornament, but without injuring the varnish.

Transparent green colour.

Artists are often embarrassed in regard to the choice of colouring matters, when they are desirous of communicating a colour to a liquid without injuring its transparency. Some colouring parts are susceptible of being dissolved in spirit of wine, and in oily substances, but not in water. Some saline preparations of copper are of this nature; while the oxides of copper resist, for the most part, the action of water, but combine with oily liquors. Other colours require mordants of an acid or alkaline nature before they combine with water, and are incapable of union with oils. Indigo, litmus, cochineal, saffron, bastard saffron, and red sandal wood, prove the truth of this statement.

This variety in the chemical properties of colouring substances, confines the application of some of them to certain vehicles and circumstances, in order to render them useful in the arts. I have often experienced difficulties when, on the faith of authors, I endeavoured to give all the colours susceptible of producing a rich effect in painting, (without altering the transparency of the coloured vehicle,) to copal varnish made with turpentine. However, the state of the substance employed in these trials, is not always what it might and ought to be: for example.—I mixed crystallized verdigris * re-

* Acetate of copper.

duced to powder with copal varnish, to give it a transparent green colour. The union was favoured by the heat of a balneum mariæ; at the moment of the mixture a part of the copal assumed the form of grains; but by the addition of a little oil of turpentine, heat, and motion, the copal was re-dissolved.

This separation of a part of the copal was probably owing to the presence of the moisture contained in the pulverized crystals: for having repeated the same experiment with perfectly dry crystallized verdigris, by projecting the powder, in small portions, into the hot varnish, it was attended with complete success. The colour resulting from this mixture was a beautiful green.

Another green colour.

The green carbonate of copper, obtained by precipitating a solution of copper in any acid, by a solution of carbonate of potash, if washed and dried, and then mixed with copal varnish, gives a beautiful green colour. It is inferior, however, to the preceding composition.

Another green colour by composition.

This green may serve as an illustration of the theory of compound colours. The mixture of two simple colours produces a compound colour, the tint of which depends on the respective quantities employed. The varnish coloured by turmeric root or gamboge, Nos. 15 and 16, mixed with the following varnish coloured by

Prussian blue, is more beautiful, smoother, and extensible than either of the green varnishes just described.

Blue colour.

If indigo could be incorporated with copal varnish, and communicate its colour to it, we should not be obliged to prepare this colour from a substance which alters its limpidity. Prussian blue serves as the basis of this colour.

The best Prussian blue of the shops communicates to varnish a very transparent blue colour; but it has not that richness of reflection and velvety appearance so agreeable to the eye when the extension of which it is capable without being weakened, has been given to it. When extended over a metallic plate, there are sometimes grains observed in it, which may be owing to its incomplete division, or to the separation of some earthy matter, which even the best Prussian blue of the shops usually contains. This blue, however, *when in a state of purity*, unites so completely with copal varnish, that its transparency does not seem to be in the least affected by it.

Superb liquid blue.

Circumstances sometimes occur to require the application of copal varnish to a colour which may have been mixed up with a gummy or mucilaginous liquid. These circumstances arise from the accidents which happen to enamel. Opaque enamels resist the action of a mineral acid; and, in like manner, transparent enamels, applied to gold and silver, may be repaired with colours, having

mineral acids for their mordant, attention being paid to their particular affinities. In regard to metals, the texture of which is inferior to that of gold or silver, colours with a mordant can be applied only by means of a gummy juice capable of defending the metallic plate from the action of the mordant. The composition of the colour, which I am about to describe, as well as that from indigo, which I shall speak of hereafter, belongs to those which require this preliminary precaution.

Put into a small matrass or common phial an ounce of fine Prussian blue, reduced to powder, and pour upon it from an ounce and a half to two ounces of strong muriatic acid. The mixture produces an effervescence, and the Prussian blue soon assumes the consistence of thin paste. Leave it in this state for twenty-four hours; then dilute it with eight or nine ounces of water, and preserve the colour, thus diluted, in a bottle well stopped.

The intensity of this colour, which is very dark, may be lessened, if necessary, by more water. If the whole of this mixture be poured into a pint (or more) of water, it will still be sufficiently dark for washing prints.

This colour, charged with its mordant, requires the use of gum water made with gum tragacanth. Mucilage of gum arabic does not possess sufficient consistence.

This colour, applied with gum water, and covered when dry with copal varnish, would form very beautiful foil.

Yellow.

Gamboge and turmeric root give very beautiful yel-

lows, and readily communicate their colour to copal varnish made with turpentine. Aloes give a varied and orange tint.

Dark red.

Dragon's blood, digested in warm varnish, gives reds, the intensity of which depends upon the quantity of the colouring resin which combines with the varnish. The artist, therefore, has it in his power to vary the tones at pleasure.

Though cochineal, in a state of division, gives very little colour to oil of turpentine in comparison of that which it communicates to water, carmine may be introduced into the composition of varnish coloured by dragon's blood. The result will be a purple red, from which various shades may be easily formed.

Violet.

A mixture of carminated varnish and dragon's blood, added to that coloured by Prussian blue, produces violet.

From these examples of the communication of colours to copal varnish, every person habituated to the operations of this art, and every amateur possessed of dexterity, may readily prepare any colour he desires.

Observations.

The reader, from what has been already said, must be convinced that copal varnish, if carefully applied, is capable of producing great richness, splendour, and solidity, when extended over surfaces which are them-

selves possessed of splendour, as is the case with metallic substances. This quality renders it proper for articles subject to percussion or to continual friction, and exposed to humidity. The application of a varnish sufficiently solid to resist these, and sufficiently transparent to preserve, and even to increase the original metallic splendour, must add, in a considerable degree, to the value of the articles.

When the copal varnish is designed for small articles, as a particular distribution of the colours is not required, it may be applied as well by an amateur as by a professed varnisher. But if large articles are to be varnished, the application of it requires practice and great care.

One of the essential conditions relates to the state of the metallic surface. It must be extremely well polished, and then be heated on an iron plate placed over a chafing-dish, till the hand can scarcely bear to touch it; and the heat must be equal in every part of it.

When this is done, dip a large flat brush, made of very soft hair, in the varnish, and draw it gently over the whole surface. This operation requires dexterity, that the different strokes of the brush may not be observed. It will, therefore, be proper not to load the brush with too much varnish at once: if these precautions are neglected, the surface of the metal will exhibit undulations, and very often it will be spotted. Turned articles, if varnished while in the lathe, by means of heat, will always be attended with the greatest success, because the extension of the varnish is more uniform, and the operation facilitates the polishing. When undula-

tions are observed, this defect may be, in part, remedied by bringing the article near the iron plate without actual contact. A gentle heat renders the varnish more uniform.

If a gold colour be required, two or three successive coatings of coloured and changing varnish may be applied, and these must be covered by another coat of the uncoloured copal varnish, No. 18. The colouring parts of the changing varnish of the third genus, No. 15, may also be communicated to the copal varnish; or you may employ the new varnish, No. 22, made with copal of one fusion.

If particular circumstances, determined by the nature of the article intended to be varnished, prevent its being heated, the varnish must be applied cold; but the article may be brought near to the fire, or exposed in a stove, the heat of which disposes the varnish to extend itself in a more uniform manner, and to appear with its whole lustre. A bright sun and pure air produce the same effect.

If these kinds of varnish become stained by use, the article must be washed with warm water, and wiped with a piece of fine linen rag. The contact of hard bodies is hurtful to them. If the case require it, a little soap may be added to the warm water.

Application of copal varnish for repairing opake enamel.

The properties possessed by these varnishes, which render them proper for supplying the vitreous and trans-

parent coating of enamel, with a covering equally brilliant, but more solid, and which adheres to vitreous compositions and to metallic surfaces, admit of their being applied to other purposes. By slight modifications they may be used also for repairing opaque enamel which has been broken. These kinds of enamel may be repaired either by coloured cements, or by coloured copal varnish applied superficially. On this account they are attended with less difficulty in repairing than transparent enamel, because they do not require the same reflection of the light. The intention of the artist will be answered by compositions of paste, the different grounds of which harmonize with the colours or ground of the pieces to be repaired, and which may be strengthened by the same tint introduced into the solid varnish, with which the articles are glazed.

The base of the cement ought to be pure, white, dry clay. If solidity be required, white lead is the only substance that can be substituted for it. Drying oil of poppy will form an excellent vehicle, and the consistence of the cement ought to be such that it can be easily extended by a knife or spatula, of a moderate degree of flexibility. This sort of paste soon dries. It has the advantage also of forming a ground which contributes to the solidity of the colours applied to it with a brush. The varnish No. 1, of the first genus, is exceedingly drying. The application of it will be proper in cases when the speedy repair of the damaged articles is required.

In more urgent cases the paste may be composed of

white lead, and the copal varnish, No. 18 or 22, which dries more speedily than oil of poppy; and the colours may then be glazed with the ethereous copal varnish, of the fourth genus, No. 17.

The application of the paste will be necessary only in cases when the accident, which has happened to the enamel, leaves too great a vacuity to be filled up by several coats of coloured varnish. But in all cases the varnish ought to be well dried, that it may acquire its full lustre by polishing.

Though it may be more convenient to apply the paste, and then to colour it superficially by coats of the requisite colours, cases may occur in which a preference ought to be given to coloured cements; and though any artist may easily determine the kind of matter proper for the purpose, it will no doubt be of some utility to give a short view of the colouring substances recommended by experience.

White.

White lead, Spanish white, white clay. Such of these substances as are preferred ought to be carefully dried. White lead and clays obstinately retain a great deal of humidity, which prevents their adhesion to drying oil or to varnish. The cement then crumbles under the fingers, and does not acquire a body.

Black.

Lamp black, black made of burnt vine twigs, black of peach stones. The lamp black must be carefully

washed, and afterwards dried. Washing carries off a great many of its impurities.

Yellow.

Naples and patent yellows reduced to impalpable powder. These yellows are damaged by the contact of iron and steel: in mixing them up, therefore, an ivory spatula and a glass mortar and pestle must be employed.

Gamboge, yellow ochre, or Dutch pink, according to the nature and tone of the colour to be imitated.

Blue.

Indigo, Prussian blue, blue verditer, and ultramarine. All these substances must be very finely powdered.

Green.

Verdigris, crystallized or distilled verdigris. Compound green (a mixture of yellow and blue). The first two require a mixture of white in proper proportions, from a fourth to two-thirds, according to the tint intended to be given. The white used for this purpose is white lead, or Spanish white, which is less solid, or white of Moudon.

Red.

Vermilion. Red lead. Different red ochres, or Prussian reds, &c.

Purple.

Cochineal, carmine, and carminated lakes, with white lead and boiled oil.

Brick red.

Dragon's blood.

Buff colour.

Dragon's blood, with a paste composed of flowers of zinc, or, what is still better, a little vermilion.

Violet.

Vermilion mixed with washed and very dry lamp black, or with the black of burnt vine twigs; and, to render it mellower, a proper mixture of red, blue, and white.

Pearl gray.

White and black; white and blue. For example, white lead and lamp black; white lead and indigo.

Flaxen gray.

White lead, which forms the ground of the paste, mixed with a small quantity of Cologne earth, as much English red, or carminated lake, which is not so durable, and a little Prussian blue.

Remarks.

It is well known that these mixtures cannot be subjected to fixed rules, in regard to the quantity of the matters which enter into their composition. They must depend on the taste of the artist, and the shade which he is desirous of giving to the colour.

All these different methods resemble a lucrative kind of painting, which gives employment to a number of hands; namely, the preparation of *foils,* or coloured laminæ, used with so much success in the manufacturing

of buttons, in embroidery, and for ornamenting a variety of toys, of which there is a very extensive and daily consumption. These very thin laminæ of silver, copper, brass, or tin, perform the same office, under the name of foil, and may be distinguished by the name of *false enamel*, as enamel covered with coloured or uncoloured copal varnish. If the latter seem to differ from foil, by their consistence, which depends upon the thickness of the metallic laminæ, and the repeated application of coats of varnish: if they differ also in the nature of the varnish itself, the use of which does not include the *sauces* * that constitute the colouring part of foil, they certainly seem to have some resemblance in the nature of their composition. With a view of gratifying those who may desire to unite the preparation of foils to that of varnishes, I shall state the only information I have been able to procure on a subject which appears to be involved in mystery.

FOIL.

The reader will recollect that some colouring substances, of an extracto-gummy nature, dissolve more readily in water than in spirit of wine or essential oils; that other colours, those prepared from mineral substances, as Prussian blue, &c. are only minutely divided without being dissolved. When the nature of the colouring parts which ornament different kinds of foil is examined, it does not always appear to be owing

* Sauce is a technical term used to describe the compositions employed in making foil.

to coloured varnishes. Some of these colouring parts belong to that kind of compositions called *sauce*, covered afterwards with a transparent varnish, which preserves them from the influence of moisture, and which produces with the metallic splendour that beautiful effect with which they are generally attended. The processes may be varied, with regard to the tone and shades of the colours, which may be easily rendered stronger or weaker. Those which I here describe produced, in part, the desired effect.

First preparation.

Immerse isinglass in pure spring water for twenty-four hours, and boil it to complete the solution. Strain the whole through a double piece of linen, or a piece of flannel, and evaporate until a trembling jelly is formed.

Second preparation.

Dip the polished metallic leaves of copper, brass, or tin, (the latter are employed only for gilt leather, and for decorating papier maché), which you wish to colour, in water mixed with a little aquafortis; for example, an eighth, a tenth, or a twelfth of acid. This immersion renders the surface of the metal rough. Then wipe it carefully immediately, and having applied the isinglass, suffer it to dry, that it may receive the colour.

Blue colour.

The beautiful liquid blue, the composition of which has been given, may be employed for this purpose. Leaves

of silver or copper ought to be preferred to those of brass, when colours with a mordant are applied. Any degree of dilution may be given to this blue by the addition of common water.

Another Blue.

Take one part of indigo, and put it into a phial placed in hot sand, with two parts of sulphuric acid. When the effervescence which takes place has subsided, add ten or twelve parts of pure water. This kind of solution renders the blue very beautiful. The observations made in treating of the preceding blue, in regard to the nature of metallic laminæ, may be applied to this kind of colour. They ought to be copper or silver.

Green.

A compound green may be made by mixing a decoction of yellow berries with a little blue liquor. It may be prepared also by the immediate employment of a solution of distilled verdigris, such as that described under this head. The sea green also may be imitated.

Red.

A dark red may be extracted from a decoction of cochineal, the tint of which can be varied by means of a large proportion of water. This red inclines to purple.

The red of Saunder's wood may be extracted by spirit of wine, the evaporation of which will furnish the means of concentrating the colouring part. The colouring part may be extracted also by water, which must after-

wards be evaporated, and the extract is then mixed with spirit of wine.

A process nearly similar may be employed to apply the rose colour of bastard saffron to foil. This colouring part is soluble in carbonate of soda. It is precipitated from the soda by means of the acid of lemon juice, which combines with the alkali. For the present operation this colouring part is separated from the supernatant water by means of some slips of cotton cloth, or cotton wicks, one end of which is immersed in the liquid, while the other hangs over the edge of the vessel. All the water is thus drawn off as if through a filter. The colouring part is then mixed with rectified spirit of wine, and spread over the metallic surfaces in successive coatings.

Violet.

The colouring part of litmus dissolves readily in water, and produces a coarse violet. It may be brightened by using rectified spirit of wine, which dissolves it as well as water.

The colouring part of litmus is held in solution by liquor of ammonia *. The colouring part which has dissolved in water, in the case of an aqueous decoction, is precipitated by the addition of a little acid of lemon: it then subsides to the bottom of the vessel. To separate the supernatant water, the same kind of filtration as that used for the decoction of bastard saffron may be

* *Liquor or solution of ammonia* is a preparation ordered in the *Phar. Lond.*, and may be obtained at any chemist's shop.—EDITOR.

employed. Concentrated decoction of litmus, applied to metallic laminæ, furnishes a speedy method of colouring.

Lilac.

Tie up the litmus in a cloth, and immerse it in water till it gives only a rose colour. Then boil it in more water, in which the remaining colour will be concentrated, and apply this decoction cold to the metallic laminæ, prepared with a solution of fish glue.

Ruby colour.

Boil carmine or carminated lake in water; and when the decoction rises, add a few drops of the liquor of ammonia. Suffer the decoction to form a deposit when cold, and employ it without filtration. A decoction of cochineal, in my opinion, might be substituted for the carmine or the lake.

Rose colour.

To make rose colour, add to the preceding a fresh quantity of water, until it is brought to the required tone. Bastard saffron gives different shades of rose colour. A decoction of Brazil-wood, mixed with a solution of tin in aqua regia, gives also tones of rose colour.

Poppy red.

Spread a stratum of the ruby colour, and over it another of infusion of saffron, prepared by maceration in cold water for forty-eight hours.

Capuchin colour, yellow and jonquil, may be made in this manner, by varying the intensity of colour.

Plum colour, and other browns.

A stratum of lilac colour, and over it a stratum of green or blue.

Remarks.

The second and third coats of colours ought not to be applied till the preceding is perfectly dry. Care must be taken also not to pass several times over the same place, because the new colour, though cold, loosens the former. It is, therefore, always advantageous to give to the colour a very dark tint; because it saves the trouble of going too often over the same surface.

These different tints of colours would not have the durability of foil, and would be easily effaced by moisture, were they not preserved by being covered with varnish. The varnishes generally appropriated to articles of this kind are those which compose the first genus; that is to say, drying varnishes made with spirit of wine. Nos. 1, 2, and 3, therefore, may be employed in such cases; and, for the better preservation of the tints, the copal varnish No. 18 or No. 22, of the fourth genus, may be used. At first it will emit some smell, but this may be remedied by a coating of spirituous varnish. Articles of this kind do not require much durability in the varnish.

General observations on Varnish, and particularly on Chinese Varnishes.

The best composition of varnish, and the most perfect

combinations in the colours, are not sufficient to display them with all that splendour which it is possible to give to them. An expert hand is required also for the application of them; and the amateur, who has not been accustomed to the labour, must possess a correct taste.

The details already given in this and the preceding chapters of the present volume, as well as in our Treatise on Painting, are sufficient to prove that the art of varnishing has been brought to greater perfection in Europe than in China and Japan, where it originated; since the processes employed among us require a much greater share of talents and knowledge.

The solid red, black, yellow &c. lacquer which comes from their manufactories is composed of only two substances. The nature, therefore, as well as limited number of the colouring parts which they employ, proves how little their national industry has derived from resources of this kind. Vermilion and red bole for the red colour, orpiment for yellow, and burnt bones or ivory for black, form the whole colouring matters of the Chinese varnisher; if we add the use of gold and silver, which he distributes with much profusion and little taste, though his method of heightening the splendour of the gold indicates a good deal of dexterity and long practice.

If we consider the nature of the two substances which serve as a base to their varnishes, and of which they are formed, they may be compared to our copal varnish of the fifth genus. One of these two substances is a fluid, resinous matter, which thickens in the air, and to which

more body is given by a kind of oil that, in the Chinese varnishes, is used for the same purpose as linseed oil in ours.

This first substance, or that which forms the varnish, is extracted from a tree called by the Chinese *tsi-chou.* It is a liquid resin, of a reddish colour, obtained from incisions made in these trees, which are cultivated in some of the provinces of the empire, and particularly in those of Kiang-si and Se-tchuen. There are three kinds of them; the resinous juice of which is distinguished by peculiar qualities, and which the Chinese apply to particular purposes *.

The varnish, used as such, is called in China *koa-kin-tsi.* Two mordants made with the same varnish are employed: one of them is mixed with orpiment for certain gold colours; and the second with vermilion. The natural colour of the latter favours the application of gold.

The extraction of this varnish requires precautions on the part of those employed in that labour, as they are exposed to noxious exhalations, which produce a dangerous kind of erysipelas. To secure themselves from these vapours, they cover the unclothed parts of their bodies with a kind of glue, which prevents them from coming into contact with the exhalation.

The second substance, which may be compared to our linseed oil, is called *girgili:* it is known also under the

* The tree which produces the true japan varnish, is said to be a species of sumach, the *Rhus Vernix.* See our Introduction, page 4.—EDITOR.

name of *tong-yeon*. With this oily matter, added to the varnish, they mix up their colours, which they extend over the polished wood. When the first coats are dry, they ornament them with various designs in different colours, which they decorate with gold or silver. They then finish their works, which exhibit more splendour and solidity than taste, and which the worst of our artists would be ashamed to imitate with regard to the design.

They employ two methods in the application of their varnish. The first, which has been described, consists in spreading the colour, mixed up with varnish, over the polished wood when perfectly dry. The second requires more care. The furniture or articles to be varnished are covered with a very hard coating, formed of a sort of paste made with hemp, paper, lime, fine sand, and some other matter, which, when properly prepared, is applied to the wood. Over this paste, when very dry, of which they compose also their figures in relief, they spread the kind of oil designed to receive the colours. This oil forms a very solid ground, on which they trace out different designs. They then spread two coats of varnish over it, and on this varnish they apply the gold, which forms the basis of their decorations. Having finished their subjects, they are glazed with a third stratum of varnish, which is polished with some soft body.

Our varnishes lose a little of their lustre when exposed to moisture; and the alteration would be still greater were they subjected to it when they come from

the hands of the artist. Those of the Chinese are not affected by moisture: it even appears that a damp atmosphere is of use to them, when in the artist's hands, or when newly finished. This effect depends merely on the nature of the substances employed in these different kinds of composition.

The tenacity of the *koa-kin-tsi* requires a method of application which must be different from ours. In China all operations of art are carried on slowly: among us the contrary is the case: and there is reason to believe that this arises from necessity. In some provinces of China, as at Pekin, where the air is very dry, the varnishers are accustomed to expose their works in their manufactories, which are more subject to humidity than to dryness. Very often this is not sufficient, since, according to the report of Father D'Incarville, who has given us excellent details on this subject, they spread wet or very damp cloths over some compositions.

Our European varnishes would certainly not admit of this method. It has, however, been established in China by experience; and it will not appear extraordinary, if we only attend for a moment to the natural effect of dry air on certain gummy or viscid mixtures.

The surface of an exceedingly viscid liquid, when exposed to the influence of dry air, begins to be hardened, and the first effect of this is to check the drying of the part of the substance which is not subjected to the same influence: the uniformity of the texture is then interrupted. The permanent tenacity of the interior part of the varnish, and the dryness of its surface, soon occasion

a shrinking in the latter, which splits or cracks. The Chinese then are obliged to keep the surface in such a state of pliableness as may preserve harmony of consistence in the whole stratum, in order that the moisture in the interior part may have time to escape. The application of wet cloths, or establishing manufactories in situations where the air can perform the same office, appears to accord perfectly with the particular nature of their varnish.

But, when the simplicity of the mechanical means employed by the Chinese is compared with all those processes, the aggregate of which constitutes what is here called the art of varnishing, considered in all the parts which connect it with the art of making paper boxes, coach-making, painting, and gilding, we shall be convinced that the imitators have, in the course of a few years, far surpassed the inventors, who in a series of ages have not been able to deviate from the servile routine, which among them confines the mechanical part of the arts to uniform and invariable processes.

CHAPTER IX.

Method of preparing waxed or varnished cloth—varnished silk—court plaster—various methods of staining wood.

It is said that the art of preparing oil cloth originated in Holland; and although it is probable that wax was formerly used in their manufacture, it has long since ceased to form one of the ingredients in the formation of oil cloth.

Every manufacturer has his own methods for preparing oil cloth. The process for common varnished cloths is, nevertheless, very simple; there are, however, others which require more intelligence, and to which the same attention is necessary as for painted cloths.

Common wax cloth or varnished cloth.

The manufacture of this kind of cloth is very simple, and may be carried on at very little expense. The cloth and linseed oil are the principal articles required for the establishment.

Common canvas, of an open and coarse texture, is extended on large frames, placed under sheds, the sides of which are open, so as to afford a free passage to the external air. The manner in which the cloth is fastened

to these frames is very simple and convenient, as, when it becomes slackened, during the application of the varnish paste, it can be again tightened. It is fixed to each side of the frame by a kind of hooks, which catch the edge of the cloth, and by pieces of strong packthread passing through holes at the other extremity of the hooks, which are tied round moveable pegs placed in the lower edge of the frame. The mechanism by which the strings of a violin are stretched or unstretched, will give some idea of the arrangement of the pegs employed for extending the cloth in this apparatus. By these means the cloth can be easily stretched or relaxed, as the oily varnish may require, in the course of the operation. The whole being thus arranged, a liquid paste, made with drying oil, which may be varied at pleasure, is applied to the cloth.

Liquid paste with drying oil.

Mix Spanish white or tobacco-pipe clay, or any other argillaceous matter, with water, and leave it at rest some hours, which will be sufficient to separate the argillaceous parts, and to produce a sediment. Stir the sediment with a broom, to complete the division of the earth; and after it has rested some seconds, decant the turbid water into an earthen or wooden vessel. By this process the earth will be separated from the sand and other foreign bodies, which subside, and must be thrown away. If the earth has been washed by the same process, on a large scale, it is divided by kneading it. The supernatant water is thrown aside, and the sediment is

placed in sieves, on pieces of cloth, where it is suffered to drain: it is then mixed up with oil, rendered drying by a large proportion of litharge, that is to say, about a fourth of the weight of the oil. The consistence of thin paste being given to the mixture, it is spread over the cloth by means of an iron spatula, the length of which is equal to that of the breadth of the cloth.

Though the earth mixed in this manner still contains water, it readily unites with the boiled oil. The water passes into the tissue of the cloth, which facilitates its evaporation; and the cloth at the same time acquires the property of not becoming too much penetrated by the oily varnish. However liquid the varnish may be, it does not transude to the inferior surface of the cloth.

When the first stratum is dry, a second is applied. The inequalities produced by the coarseness of the cloth, or by an unequal extension of the paste, are smoothed down with pumice stone. The pumice stone is reduced to powder, and rubbed over the cloth with a piece of soft serge or cork dipped in water. A whole pumice stone, one of the faces of which has been ground smooth, may also be employed. The cloth must then be well washed in water to clean it; and, after being suffered to dry, a varnish of gum lac, dissolved in linseed oil boiled with turpentine, and which is liquefied with oil of turpentine, if necessary, is then applied to it.

This preparation produces yellowish varnished cloth. When you are desirous of rendering it black, nothing will be necessary but to mix lamp-black with the Spa-

nish white, or tobacco-pipe clay, which forms the basis of the liquid paste. Various shades of gray may be obtained, according to the quantity of the lamp-black which is added. Umber, Cologne earth, and different ochrey argillaceous earths, may be used to vary the tints, without causing any addition to the expense.

Fine printed varnished cloths.

The process just described for manufacturing common varnished and polished cloths, may serve to give some idea of that employed for making fine cloths of the same kind, decorated with a coloured impression. At first this kind of manufacture was confined to common cloths, with a smooth ground of different colours. Industry, however, has given it greater extent, by finding on the palette of the painter all those materials capable of making this new art rival that of printed cloths. The firmness of the texture of the cloth, still increased by that of a pliable covering impermeable to water, opened a very lucrative sale for this kind of manufacture, in consequence of a more careful application of the colours, which could be subjected to all the rules of design. The manufactories of Germany, indeed, have varnished cloths embellished with large and small subjects, figures, and landscapes, well executed, and which being designed for covering furniture subjected to daily use, gave certain support to this branch of industry.

This new process, which is only an improvement of the former, requires a finer paste, and cloth of a more

delicate texture. The stratum of paste is applied in the same manner, and when dry and polished, the cloth is taken from the frame and removed to the painter's table, where the art of the colourist and designer is displayed under a thousand forms; and, as in that of printed cottons, exhibits a richness of tints, and a distribution of subjects, which discover taste, and ensure a ready sale for the articles manufactured.

The processes, however, employed in these two arts to extract the colouring parts, are not the same. In the art of cotton-printing the colours are extracted by solution, as in that of dyeing. In printing varnished cloths, the colouring parts are the result of the union of drying oil mixed with varnish, and the different colours employed in oil painting or painting in varnish.

The varnish applied to common oil cloth is composed of gum lac and drying linseed oil; but that designed for printed varnished cloths requires some choice, both in regard to the oil and to the resinous matter which gives it consistence. Prepared oil of poppy and copal form a pliable and solid varnish, possessing very little colour.

The unpleasant smell arising from oiled or varnished cloths, may be removed from them by simply exposing them to the action of a chlorine fumigation in a close room. See *Transactions of the Royal Academy of Sciences of Paris*, in the *Journal of the Royal Institution* for Aug. 1831.

Varnished silk.

There are two kinds of varnished silk; one employed for making umbrellas, coverings for hats, &c.; and the other known under the name of *sticking plaster*, or *court plaster.*

The first is prepared in the same manner as the varnished and polished cloths already described, but with some variation in the choice of the matters employed to make the liquid paste or varnish with which the silk is covered. The basis of the second is a gelatinous stratum, which is afterwards covered with a varnish of the first genus: that is to say, a spirituous varnish, exceedingly simple in its composition.

For the preparation of the former, if the surface of the silk be pretty large, it is made fast to a wooden frame furnished with hooks and moveable pegs, such as that used in the manufacture of common varnished cloths. A certain quantity of a soft paste, composed of linseed oil, boiled with a fourth part of litharge, white of Troyes, Spanish white or tobacco-pipe clay, lamp black and litharge, is then prepared in nearly the following proportions: tobacco-pipe clay, dried and sifted through a silk sieve, sixteen parts; litharge ground with water, dried and sifted in the same manner, three parts; lamp black, one part. This paste is then spread in an uniform manner over the surface of the silk, by means of a long knife, having a handle at each extremity.

In summer, twenty-four hours are sufficient for its desiccation. When dry, the knots produced by the ine-

qualities of the silk are smoothed with pumice stone. This operation is performed with water; and, when finished, the surface of the silk is washed. It is then suffered to dry, and the copal varnish of the fifth genus, No. 23, is applied.

If it be intended to polish this varnish, it will be proper to apply a second stratum; after which it is polished with a ball of cloth and very fine tripoli, or with a piece of strong cloth only. The varnished silk which results from this process is very black, exceedingly pliable, and has a fine polish. It may be rumpled a thousand ways without retaining any fold, or the mark of a fold. It is light; and this quality renders it proper for coverings to hats, and for making cloaks and caps, so useful to travellers in the time of rain.

When manufacturers wish to turn old remnants of silk to advantage, whatever may be their colour, which do not exceed half a yard in length, they think it sufficient to fasten them to frames of the same size with a piece of packthread, keeping them as much stretched as possible. The liquid paste is then poured over the silk in small portions, and spread out by means of a common knife with a round point, somewhat like that of a table knife, to prevent the cloth from being cut. The handle of the knife stands at right angles to the blade, so that all the movements required for extending the paste can be made without the fingers touching the silk, and without removing the blade from an exactly horizontal position: a little practice will enable the workman to render the surface of the silk as smooth in this case as in that where

a large blade is employed in the operations on a larger scale.

In the last place, if the silk consists of long narrow bands, the mechanism employed for making two or three yards of plaster at once may be used.

Provide a common smooth table, eighteen or twenty inches square, and placed perfectly horizontal. At the two extremities of this table let there be fixed two iron screws in a perpendicular direction, which pass through two rings at the extremities of an iron rule, or blade, which stands in a vertical position, and which can be moved nearer to or further from the table by means of two nuts fitted to the screws. To determine the thickness of the stratum of the composition to be spread over the cloth, there are placed close to the screws, and between the rule and the table, as many squares cut from a common card as may be necessary to give the thickness required: two or three will be sufficient.

When this arrangement has been made, place one of the ends of the cloth between the rule and the table, in such a manner that it may pass beyond the former about an inch, that you may be able to draw it towards you during the operation; then pour the composition on the cloth near the interior side of the rule, in such a manner as to cover the cloth throughout its whole breadth. Care must be taken to make the matter continue running, while another person draws the cloth towards him, till the whole of it has been subjected to the pressure of the rule. By this mechanism the stratum will have an uniform thickness, and will be so even as

to have no need of being smoothed with pumice stone. When the stratum is dry, cover it with the copal varnish, No. 23.

It was with a similar composition, and by an analogous process, that an artist of Geneva, named Louvrier, prepared his pliable varnished silk, specimens of which he presented to the Society of Arts: the same paste also, covered with a varnish, he applied to linen, felt, leather, &c.; and the use of it might be rendered more beneficial and extensive, by applying it to boots, half-boots, and shoes, which might in this manner be rendered impermeable to water.

Another kind of varnished silk.

A kind of varnished silk, which has only a yellowish colour, and which suffers the texture of the stuff to appear, has been some time in use. The matter employed in the preparation of it is a plain varnish. The silk is covered with a mixture of three parts boiled oil of poppy, and one part of fat copal varnish, which is spread with a coarse brush, or with a knife. Two coats are sufficient when the oil has been freed from its greasy principles over a slow fire, or when it has been boiled with a fourth part of its weight of litharge.

The inequalities are removed by pumice stone and water; after which the copal varnish is applied. This simple operation gives a yellow colour to white silk, which arises from the boiled oil and the varnish.

This varnished silk possesses all those qualities ascribed to certain preparations of silk which are re-

commended to be worn as jackets by persons subject to the rheumatism.

Sticking Plaster, or Court Plaster.

The preparation of sticking plaster, or court plaster, is still simpler: the basis of the first stratum is isinglass.

Bruise a sufficient quantity of isinglass, and let it soak for twenty-four hours in a little warm water; expose it to heat over the fire, to dissipate the greater part of the water, and supply its place by proof spirit of wine, which will combine with the isinglass. Strain the whole through a piece of open linen, and take care that the quantity of the solvent be such that on cooling it shall form a trembling jelly.

Extend a piece of black silk on a wooden frame, and fix it in that position by means of tacks, or pack-thread. Then with a brush made of badger's hair, apply the isinglass, after it has been exposed to a gentle heat to render it liquid. When this stratum is dry, which will soon be the case, apply a second, and then a third, if you are desirous of giving the plaster a certain degree of thickness. As soon as the whole is dry, cover it with two or three coats of a strong tincture of balsam of Peru.

This is the real English court plaster: it is pliable and never breaks; characters which distinguish it from so many other preparations sold under the same name.

This article has been adulterated as well as many others. A kind of plaster, the covering of which is very thick and brittle, is often sold under the same name. The fabricators of this article, instead of isinglass, which

is dear, employ strong common glue, which they cover with spirituous varnish, like those of the first genus. This plaster cracks, and never has the balsamic odour by which the real English court plaster is particularly characterized. To detect this fraud, nothing will be necessary but to rub it a little.

When you wish to use the English plaster, moisten it with saliva, or warm water, on the side opposite to that which is varnished, and it will adhere exceedingly well. The adulterated plaster is too hard to adhere by so simple a preparation; it requires to be moistened on the varnished side.

VARIOUS METHODS OF STAINING WOOD.

A red stain.

Take of Brazil wood, in chips, 1 pound.
Pearl-ash, 1 ounce.
Water, 1 gallon.

Let them stand together two or three days, during which time the mixture should be frequently stirred. Then boil it for two or three hours; and while boiling hot brush over the wood intended to be stained three or four times, or oftener, till the proper tint is obtained. While wet, brush it over with a solution of alum in water, made in the proportion of two ounces of alum to a quart of water.

A lighter red, approaching pink.

Add to a gallon of the above infusion two additional ounces of pearl ash. The wood in this case should be often brushed over with the solution of alum.

By increasing the quantity of pearl-ash the red may be rendered still paler; but when more pearl-ash is added, a proportionate quantity of the solution of alum will be also required.

A very dark red stain.

Take of logwood, in chips, $\frac{1}{2}$ a pound.
Salt of tartar, 1 ounce.
Water, 2 quarts.

Boil the logwood chips in the water till it becomes of a very dark red colour; then add the salt of tartar, and boil for two hours more. The decoction must be applied to the wood boiling hot.

The old method of colouring wood red.

Dissolve one ounce of dragon's blood in one pint of rectified spirit of wine; brush the wood over with this varnish till it appears of the required colour.

A yellow stain.

Take of turmeric root, in powder, 1 ounce.
Rectified spirit of wine, 1 pint.

Digest for four days, shaking occasionally the mixture, when it may be strained off for use. Let it be applied to the wood by brushing it over three or four times, taking care that the first stain is dry before the second is applied. If the colour be required of a reddish cast, a little dragon's blood may be added to the mixture.

Another yellow stain.

Take of French berries, 1 pound.
Alum, $\frac{1}{2}$ an ounce.
Soft water, 1 gallon.

Boil them together for two hours, and while boiling brush over the wood with the decoction till it becomes of the colour required. After the stain has been some hours applied, so that the wood is become quite dry, brush it over with a weak solution of alum water.

Blue stains.

Wood may be stained blue by either a solution of *copper* or of *indigo*.

Copper will produce a brighter colour, and is more generally practicable.

A blue stain with copper.

Dissolve copper filings, or slips in aqua fortis, adding the filings or slips to the acid till all effervescence ceases; to the solution add of starch, finely powdered, the weight of one-fifth of the weight of the copper dissolved. Make now a solution of pearl-ash in water; put as much of this solution to the solution of copper as will cause the copper to precipitate in a fine green powder. On the first addition of the pearl-ash solution, the liquid will appear of a dark muddy green; but by adding more of the pearl-ash solution, it will soon become clear, and the precipitate assumes a fine green colour. The clear part must be poured off, and the precipitate washed in

three or four quantities of clear water, till the water becomes tasteless. Let the precipitate be dried for use; which is, in fact, a *verditer*.

After the wood, intended to be stained, has been brushed over in a similar way as described for other colours, till it is stained a dark green, make a solution consisting of two ounces of pearl-ash in a pint of water, and brush it over the wood boiling hot, when it will appear of a fine deep blue colour.

A green stain

May be made with the same precipitate of any tint, by merely omitting the solution of pearl-ash, and brushing the mixture over the wood once or more, according to the tint required.

A blue stain with indigo.

Dissolve indigo in sulphuric acid, as directed in *Packer's Dyer's Guide*, page 46; or a *liquid blue* may be prepared thus: put three ounces of indigo, in powder, to one pound of sulphuric acid. When the indigo is dissolved, which it will be in about twenty-four hours, provided the mixture has been occasionally stirred, add to the solution one pint of boiling water.

This solution must be applied to the wood boiling hot. Dissolve by boiling three ounces of cream of tartar in a quart of water; with this solution, used copiously, brush over the wood before the moisture of the indigo is quite absorbed.

A purple stain.

Take of logwood chips, 1 pound.
Brazil wood chips, 4 ounces.
Water, 1 gallon.

Boil these together for two or three hours. The decoction must be applied boiling hot. When dry, brush it over with a solution containing a quarter of an ounce of pearl-ash to half a gallon of water. This solution must be carefully used, as it gradually changes its colour from a brown red, which it originally is, to a dark blue purple, and therefore its effects must be carefully noted to make the desired colour.

A black stain.

Brush the wood several times with the hot decoction of logwood described in the last article, omitting the Brazil wood; next prepare an infusion of galls thus:—

Take of powdered galls, 4 ounces.
Water, 2 quarts.

Place them in a gentle heat for three or four days; brush the wood over with this infusion three or four times, and then pass over the wood again with a solution composed of two ounces of sulphate of iron and a quart of water.

A very fine black

May be produced by brushing the wood several times over with a solution of copper in aqua fortis, and afterwards with the decoction of logwood, which must be

repeated till the desired colour is obtained, and the greenness of the copper wholly overcome.

A common black stain

Is produced by immersing a pound of iron nails into half a gallon of vinegar, with a small quantity of verdigris.

This is the common black stain for chairs; it is also useful to mix with colours that require grain, as rosewood, tulip, &c.

Mahogany stains.

These stains are very useful, and if well prepared and applied to suitable wood, resemble real mahogany.

A light red brown mahogany.

Take of madder root, in powder, $\frac{1}{2}$ a pound.
Fustic chips, 4 ounces.
Water, 1 gallon.

Boil together for two or more hours. This decoction must be applied to the wood boiling hot, till the proper colour is obtained. If the grain of the wood be not sufficiently varied, a varnish brush dipped in the black stain, and passed lightly over the wood, while wet, will greatly improve it, and give it the appearance of dark Honduras mahogany.

A fine mahogany stain

Is produced by mixing the tincture of dragon's blood, and turmeric root in spirits of wine. By diminishing

or increasing the proportion of each of the ingredients, the brown stain may be varied to a more red or yellow cast at pleasure.

Spanish mahogany stain.

Take of madder root, in powder, $\frac{1}{2}$ a pound.
Fustic chips, 1 ounce.
Logwood chips *, 2 ounces.
Water, 1 gallon.

Boil for two or more hours. Apply the decoction boiling hot. When the wood has been brushed over several times, and is become dry, let it be slightly brushed over with a solution containing a quarter of an ounce of pearl-ash in a quart of water.

Any stain of intermediate colours may be made by varying the proportion of the ingredients.

Fancy woods.

The preceding stains may, by judicious management, be combined in various ways, so as to represent many variegated woods. *Rosewood* in particular may be thus imitated.

Rosewood stains.

The articles chiefly stained to imitate rosewood are chairs, which are commonly for such purpose made of beech.

* Fustic *chips* and logwood *chips* are here ordered, because the *powder* of these woods is more likely to be adulterated.

They are usually dipped in a large copper containing the boiling *red stain*, then taken out and dried before they are dipped again. When the red stain is acquired, a flat varnish brush, having its hairs separated, is dipped in the *black stain*, and drawn over the chairs which are stained red.

In concluding these directions for staining woods, for which we are chiefly indebted to *Whittock's Decorative Painter's and Glazier's Guide*, (noticed in page 51 of our present volume,) it is obvious that the application of some *polish* to such woods is necessary to render them pleasing to the eye. The *French polish* mentioned in page 141, will be found extremely useful for such purpose; so also will some of the best spirit varnishes; and even *good drying oil* may be advantageously applied with the assistance of *friction*, as a polish to these woods.

We ought not, perhaps, to close this chapter without repeating again here what WHITTOCK says in regard to *drying oil*, namely, that "the most simple method of preparing it is by boiling it without any addition."—See page 51.

CHAPTER X.

CONCLUSION.

On the instruments necessary in the art of the varnish-maker.

THE premises of the *varnish-maker* must be accompanied with a court or yard for the preparation of the varnishes, in order that he may be protected, as well as his neighbours, from the damage which may be occasioned by negligence or other causes.

Liquid substances require to be kept in glass or stone ware. Varnishes should be kept in large strong black glass bottles with a wide mouth, for the convenience of taking them out; but as light has a powerful influence on them, and renders them thick, we recommend wrapping up the bottles in sheep's skin or moist parchment, folding it round the neck, and tying it with several turns of pack-thread. This addition is attended with the double advantage of guarding against the action of light, and of preventing those accidents which result from percussion.

Drying oils are less delicate than varnishes made with spirit of wine or oil of turpentine. They may be preserved exceedingly well in stone-ware jars, in large

bottles, or in leaden vessels with a wide mouth. Leaden vessels are not liable to those accidents which are most to be apprehended; and if this advantage be not sufficient to cause them to be preferred, they possess another, well known, and consistent with theory, which is, that they add to the drying quality of the varnish. Varnishes are, however, in the large way in this country, most commonly kept in earthen bottles, made of what is called *stone-ware;* or in a large black glass bottle packed with straw in a basket, and usually denominated a *carboy.*

A table, weights, and scales, and a few boards to form shelves, are all the utensils necessary for the workshop of the varnish-maker.

The expense of fitting up a *laboratory* to furnish articles for common consumption will be very small. The instruments indispensably necessary are—

An alembic, constructed according to the principles explained in this work, with a refrigerator and portable furnace.

If the operator should not choose to go to the expense of the alembic, and the rest of the apparatus, as described in page 125, a succedaneum may, in some degree, be found for them in a *sand-bath* or *sand-heat* (as it is more commonly called), and the use of *retorts,* under suitable precautions.

A sand-heat is usually formed, in the large way, of an oblong shape, having bricks and mortar for its walls, plates of iron upon which to lay the sand, and around the top a ledge, of about six or eight inches deep, of

free stone, to retain the sand; beneath the plates of iron is a wide flue, at the bottom of which is iron grating, and upon which grating is laid the fire: the fire is of course, when kindled, enclosed by a door, as in other furnaces, at the end of the sand-heat; the flue communicates with a chimney, to carry off the smoke. The sand is commonly of the depth of six or eight inches; but the quantity and depth of it must depend upon the size of the vessels immersed in it.

A retort scarcely needs to be described: it is usually made of green or other glass, and may be made to hold from a pint to eight or more gallons. It has a long narrow neck, which is so bent that, when the retort is placed with its contents in the sand, it has a gentle inclination, and will conduct whatever liquid is condensed in it into a glass receiver, which is placed on a bench beside the sand-heat; the receiver is luted to the neck of the retort either by a wet bladder-skin, which is the neatest way, or by some other lute.

A variety of chemical processes are thus conducted: the vapours raised by the heat being condensed in the neck of the retort, and cooled down in the receiver, (which is usually about the size of the retort,) by the large surface which it presents to the air. But this simple process will not be, in general, adequate to the preparation of spirit varnish: for the vapours rise so soon, and their expansion is so great, that an explosion may often occur.

If, however, a glass tube be adapted to the neck of the retort, the receiver removed at a greater distance

from the fire, and the tube inserted into it, and if over the tube be placed a vessel of *cold* water, having a cock at its bottom, which may be made to drop the water gradually on the tube, and thus, by its evaporation, condense the vapours of the spirit within, a succedaneum for the alembic described in page 125, may, in some degree, be found.

This process is generally adopted in the preparation of ether, and for that answers admirably well.

A *portable sand-heat* may consist of an iron pot, in which the sand is placed, and the pot may be made to suit an ordinary furnace.

A few bottles for receivers, that is to say, of a pretty large capacity, with different funnels of glass and of tin plate.

Two or three copper basins of different sizes, according to the extent given to the establishment.

Vessels of earthen-ware to receive the varnish, which is strained through a cloth, and to contain the first deposit.

Pieces of board of the same diameter as the earthen vessels, to serve them as covers. They are more convenient, and not liable to be broken like the earthen-ware ones commonly employed.

Large glass jars, furnished with funnels, and the latter with covers, for filtering the varnishes of the first, second, and third genera.

A cast iron pot, polished in the inside, and furnished with a cover, for making varnish of the fifth genus.

Different spatulas of wood, rounded at the end.

A shovel and a pair of tongs.

Two or three furnaces of different diameters, and, in particular, a small one, with a sand-bath.

A small iron-hooped tub, with handles, to contain charcoal.

An iron capsule, or small vessel, with a short handle, to take out the charcoal.

Some glass matrasses, of different sizes, for the immediate preparation of alcoholic varnish; which is effected by immersing the matrass in a basin, the water of which is raised to different degrees of heat up to that of ebullition.

A fixed table, some small tables, and a few boxes.

A bottle filled with spirit of wine, to prevent the consequences of burns *.

If the spirit be applied the moment the accident happens, it prevents the rising of blisters, which retard the cure. If the burn be considerable, the application of fresh yolk of eggs is the best substance to allay the pain and to promote a cure. Simple cerate, composed of one part of yellow wax and two parts of good olive oil, or of three parts in winter, produces an effect which may be compared to that of yolk of eggs, and is less expensive.

An iron mortar of from twelve to fifteen inches in diameter, with an iron pestle.

Brushes and pencils of different kinds. In regard to those designed for varnish, washing in spirit of wine, or

* Oil of turpentine is, we believe, much better for such purpose.—EDITOR.

oil of turpentine, as the case may be, will restore them to a clean state. If, however, the varnish has been suffered to dry on or between the hairs, a few strokes of a hammer or mallet will pulverise and separate the resin, and thus restore the brush to its customary pliability.

These are the chief articles necessary in the workshop of the varnish-maker; but, of course, where new processes are adopted, and which the ingenuity of the varnish maker might invent, it is not in our province to describe the instruments which may be employed.

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